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VIEWS, NEWS AND INTERVIEWS.

The six Bright brothers, of Adrian, Mo., were struck by lightning the other day. Jove loves a shining mark.—*New York Sun.*

A fender for electric cars that marks an advancement over those at present in use was exhibited at Crescent Beach, Mass., a few days ago, before members of the city government and business men of Boston. The inventor is M. F. Field, of Boston, who claims that with this fender any object or person on the track will be easily and safely removed. The fender is materially different from any seen on the cars at present. It extends in front of the car 24 inches, and is formed of a series of steel wires that curve from the platform in a gentle swell to the bar in the front of the fender, which is a few inches above the track. A body striking the fender is scooped up on to the wires owing to their elasticity, and the weight bends the wires so as to prevent its rolling off in front of the car.

It is expected that the system of electric light buoys running from Chicago harbor to the World's Fair grounds will be in operation this week.

A promising invention in telephone circles is the "nickel-in-the-slot" telephone, one of which has been placed in Willis' Hotel, at Wilmington, Del. All you are compelled to do is to drop in your nickel, dime, or whatever it may be, and the telephone does the rest. Slots are made for a nickel, dime, a quarter, half-dollar and a dollar. When either of the above denominations is dropped in the slot, the telephone rings at the exchange, and then the operator knows how much money has been dropped in the slot and how long and to what point the person is entitled to talk. The invention is gradually finding a field of usefulness.

Probably the best dampener for the vibrations of a high speed electric fan motor is a pad of soft felt about half an inch thick, placed under the base of the motor. A pad formed of folded newspapers and excelsior has also been noted in satisfactory service.

A simple method of testing incandescent lamps as to the condition of the vacuum and probable life of the filaments is mentioned in a French paper. As large a number of lamps as possible is arranged on a testboard provided with a rheostat, care being taken only to have at one time lamps of equal voltage and luminous intensity. The lamps are then tested at a low voltage, which allows of those of a darker red than the average being immediately observed. These are noted as doubtful; then current at a higher pressure is passed and the less brilliant lamps noted. Finally, the lamps are energized at from seven to eight volts higher than the normal. Some of the lamps will not withstand this excess of pressure, and it is suggested that they should be returned to the makers. The lamps already noted as doubtful are afterwards run for 24 hours at their normal voltage, at the end of which very few remain intact, and even these cannot, it is said, be relied upon.

Owing to the lack of power the illumination of the electric buoys at the World's Fair on June 21 was only a dim one. Every lamp burned, showing that the system was in order. After waiting several hours for power the illumination was postponed. When the line is in working order it will be accepted for the United States, and when the Exposition shall have closed it will be put in operation in New York harbor.

The New Bedford, Mass., *Mercury* estimates that 1,500,000 words were telegraphed from that city during the Borden trial. The cost to the newspapers for telegraphing alone was at least $7,500.

The Paris Fire Alarm System.

The French journal *Électricité* has recently published a series of interesting and copiously illustrated articles on the electric signaling system used by the fire department of Paris. The last number contains a diagram of the city, showing the location of automatic alarm boxes, central station, etc. The number of such boxes is unusually large, showing that the Paris fire department, certainly as far as efficient means of speedy communication is concerned, is not surpassed by any American installation of a similar nature.

THE PARIS FIRE ALARM SYSTEM.—AN ALARM BOX.

Prior to the introduction of automatic alarms called "avertisseurs publics," there existed 133 city stations "postes-vigies," distributed throughout the various quarters of the metropolis. Each one of these posts was connected by telegraph to the next fire station, but the system proved slow, clumsy, and was liable to many mechanical derangements.

The new plan dispenses entirely with these "postes-vigies," using in their stead automatic alarm boxes. For that purpose the entire city has been divided into 24 districts with a central station situated as nearly as possible in the middle of each district. Each station contains an engine, trucks, ladders, etc. It is in charge of an officer with 30 men, and in addition to the above mentioned apparatus there are a number of auxiliary devices, such as pipes, nozzles, etc. The conductors of all the automatic boxes of a district converge to the central station.

Again, each district contains two distinct lines terminating in a Morse apparatus at the central station. By this arrangement it is found that the length of cable conductor is minimized; moreover, it gives a high degree of working efficiency to the system in case of accident to one of the line wires.

As soon as a call comes in, the officer in charge sends the required number of men to the designated point. Arrived there, they communicate at once by telephone with the central station, giving full particulars concerning the nature of the fire. In turn, the central station may then communicate with the nearest central, and, if necessary, with the head of the fire department, called "l'état-major."

The automatic box has two doors, one of which can only be opened by a special key. This compartment is furnished with a movable telephone and a calling key. Since the introduction of the alarm box service, the number of dangerous fires has considerably decreased; on the other hand, the department keeps a strict surveillance and inspection over each piece of apparatus. They are tested once every day and carefully inspected each week.

It will be of interest to the American telephone engineer to hear that the telephone used is one constructed and devised by Krebs, which, as will be remembered, permits of the easy adjustment of the distance separating the magnetic core and the diaphragm. The telephone itself serves to give an audible return signal, informing the sender that his message has been received and will be attended to.

Another improvement consists in the use of cable conductors constructed on the Fortin-Hermann plan. One of the wires is set aside for the transmission of telegraphic signals, using the earth as the return, while both conductors are utilized for the telephonic service. This arrangement avoids another drawback, *i. e.*, the introduction of unequal resistance in the two sides of the circuit. This is done by placing the alarm devices alternately in one of the conductors, so that even in case of accidents to one of them the apparatus connected in the other branch remains unaffected. In case of important fires several boxes may be pulled at the same time. One instance of this kind has happened, resulting in an interference of signals. Without the telephonic intercommunication, this trouble might have been productive of serious consequences, but as it was, quick and efficient service could, nevertheless, be rendered by the department.

In conclusion, a word in regard to the Krebs telephone. This instrument was adopted because it proved superior to such microphones as have been tried. The loudness of sound is amply sufficient and the alarm (the return signal) which it emits can easily be heard at a distance of several meters. It should be noted that this return signal is produced by throwing an intermittent current on the line, which is of a polarity to strengthen the magnetization of the magneto transmitter.

In addition to such public fire alarm boxes, the Paris fire department has placed similar devices in private and public buildings, and intends to increase their number rapidly.

On Light and Other High Frequency Phenomena.

A LECTURE DELIVERED BEFORE THE FRANKLIN INSTITUTE, AT PHILADELPHIA, FEBRUARY 24, 1893, AND BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., MARCH 1, 1893.

BY NIKOLA TESLA.

(*Continued from page 228.*)

In Fig. 20 I is shown a plan which has been followed in the study of the resonance effects by means of a high frequency alternator. C is a coil of many turns, which is divided in small separate sections for the purposes of adjustment. The final adjustment was made sometimes with a few thin iron wires (though this is not always advisable), or with a closed secondary. The coil C is connected with one of its ends to the line L from the alternator G, and with the other end to one of the plates c of a condenser $c\,c_1$, the plate (c_1) of the latter being connected to a much larger plate P_1. In this manner, both capacity and self-induction were adjusted to suit the dynamo frequency.

As regards the rise of potential through resonant action, of course, theoretically, it may amount to anything, since it depends on self-induction and resistance, and since these may have any value. But in practice one is limited in the selection of these values, and besides these, there are other limiting causes. One may start with, say, 1,000 volts, and raise the electromotive force to 50 times that value, but one cannot start with 100,000 and raise it to 10 times that value, because of the losses in the media, which are great, especially if the frequency is high. It should be possible to start with, for instance, two volts from a high or low frequency circuit of a dynamo, and raise the electromotive force to many hundred times that value. Thus coils of the proper dimensions might be connected each with only one of its ends to the mains from a machine of low electromotive force, and though the circuit of the machine would not be closed in the ordinary acceptance of the term, yet the machine might be burned out if a proper resonance effect would be obtained. I have not been able to produce, nor have I observed with currents from the dynamo machine, such great rises of potential. It is possible, if not probable, that with currents obtained from apparatus containing iron, the disturbing influence of the latter is the cause that these theoretical possibilities cannot be realized. But if such is the case, I attribute it solely to the hysteresis and foucault current losses in the core. Generally it was necessary to transform upward, when the electromotive force was very low, and usually an ordinary form of induction coil was employed, but sometimes the arrangement illustrated in Fig. 20 II has been found to be convenient. In this case a coil C is made in a great many sections, a few of these being used as a primary. In this manner both primary and secondary are adjustable. One end of the coil is connected to the line L_1 from the alternator, and the other line, L, is connected to the intermediate point of the coil. Such a coil with adjustable primary and secondary will be found also convenient in experiments with the disruptive discharge. When true resonance is obtained, the top of the wave must, of course, be on the free end of the coil, as, for instance, at the terminal of the phosphorescence bulb B. This is easily recognized by observing the potential on a point on the wire W nearer to the coil.

In connection with resonance effects and the problem of transmission of energy over a single conductor, which was previously considered, I would say a few words on a subject which constantly fills my thoughts, and which concerns the welfare of all. I mean the transmission of intelligible signals, or perhaps even power, to any distance without the use of wires. I am becoming daily more convinced of the practicability of the scheme; and though I know full well that the great majority of scientific men will not believe that such results can be practically and immediately realized, yet I think that all consider the developments in recent years by a number of workers to have been such as to encourage thought and experiment in this direction. My conviction has grown so strong that I no longer look upon this plan of energy or intelligence transmission as a mere theoretical possibility, but as a serious problem in electrical engineering, which must be carried out some day. The idea of transmitting intelligence without wires is the natural outcome of the most recent results of electric investigations. Some enthusiasts have expressed their belief that telephony to any distance by induction through the air is possible. I cannot stretch my imagination so far, but I do firmly believe that it is practicable to disturb by means of powerful machines the electrostatic condition of the earth, and thus transmit intelligible signals, and perhaps power. In fact, what is there against the carrying out of such a scheme? We now know that electric vibration may be transmitted through a single conductor. Why then not try to avail ourselves of the earth for this purpose? We need not be frightened by the idea of distance. To the weary wanderer counting the mile posts the earth may appear very large, but to that happiest of all men, the astronomer, who gazes at the heavens and by their standard judges the magnitude of our globe, it appears very small. And so I think it must seem to the electrician, for when he considers the speed with which an electric disturbance is propagated through the earth all his ideas of distance must completely vanish.

A point of great importance would be, first, to know what is the capacity of the earth and what charge does it contain if electrified? Though we have no positive evidence of a charged body existing in space without other oppositely electrified bodies being near, there is a fair probability that the earth is such a body, for by whatever process it was separated from other bodies—and this is the accepted views of its origin—it must have retained a charge, as occurs in all processes of mechanical separation. If it be a charged body insulated in space its capacity should be extremely small, less than one-thousandth of a farad. But the upper strata of the air are conducting, and so, perhaps, is the medium in free space beyond the atmosphere, and these may contain an opposite charge. Then the capacity might be incomparably greater. In any case it is of the greatest importance to get an idea of what quantity of electricity the earth contains. It is difficult to say whether we shall ever acquire this necessary knowledge, but there is hope that we may, and, that is, by means of electrical resonance. If ever we can ascertain at what period the earth's charge, when disturbed, oscillates with respect to an oppositely electrified system or known circuit, we shall know a fact possibly of the greatest importance to the welfare of the human race. I propose to seek for the period by means of an electrical oscillator, or a source of alternating electric currents. One of the terminals of the source would be connected to earth as, for instance, to the city water mains, the other to an insulated body of large surface. It is possible that the outer conducting air strata or free space contains an opposite charge, and that, together with the earth, they form a condenser of very large capacity. In such case the period of vibration may be very low, and an alternating dynamo machine might serve for the purpose of the experiment. I would then transform the current to a potential as high as it would be found possible, and connect the ends of the high tension secondary to the ground and to the insulated body. By varying the frequency of the currents, and carefully observing the potential of the insulated body, and watching for the disturbance at various neighboring points of the earth's surface, resonance might be detected. Should, as the majority of scientific men in all probability believe, the period be extremely small, then a dynamo machine would not do, and a proper electrical oscillator would have to be produced, and perhaps it might not be possible to obtain such rapid vibrations. But whether this be possible or not, and whether the earth contains a charge or not, and whatever may be its period of vibration, it certainly is possible—for of this we have daily evidence—to produce some electrical disturbance sufficiently powerful to be perceptible by suitable instruments at any point of the earth's surface.

Assume that a source of alternating currents S be connected, as in Fig. 21, with one of its terminals to earth (conveniently to the water mains) and with the other to a body of large surface P. When the electric oscillation is set up there will be a movement of electricity in and out of P, and alternating currents will pass through the earth, converging to, or diverging from, the point C where the ground connection is made. In this manner neighboring points on the earth's surface within a certain radius will be disturbed. But the disturbance will diminish with the distance, and the distance at which the effect will still be perceptible will depend on the quantity of electricity set in motion. Since the body P is insulated, in order to displace a considerable quantity the potential of the source must be excessive, since there would be limitations as to the surface of P. The conditions might be adjusted so that the generator or source S will set up the same electrical movement as though its circuit were closed. Thus it is certainly practicable to impress an electric vibration at least of a certain low period upon the earth, by means of proper machinery. At what distance such a vibration might be made perceptible can only be conjectured. I have on another occasion considered the question how the earth might behave to electric disturbances. There is no doubt that, since in such an experiment the electrical density at the surface could be but extremely small, considering the size of the earth, the air would not act as a very disturbing factor, and there would not be much energy lost through the action of the air, which would be the case if the density were great. Theoretically, then, it could not require a great amount of energy to produce a disturbance, perceptible at great distance, or even all over the surface of the globe. Now, it is quite certain that at any point within a certain radius of the source S, a properly adjusted self-induction and capacity device can be set in action by resonance. But not only can this be done, but another source S_1, Fig. 21, similar to S, or any number of such sources can be set to work in synchronism with the latter, and the vibration thus intensified and spread over a large area, or a flow of electricity, produced to or from the source S_1, if the same be of opposite phase to the source S. I think that beyond doubt it is possible to operate electrical devices in a city through the ground or pipe system by resonance from an electrical oscillator located at a central point. But the practical solution of this problem would be of incomparably smaller benefit to man than the realization of the scheme of transmitting intelligence, or perhaps power, to any distance through the earth or environing medium. If this is at all possible, distance does not mean anything. Proper apparatus must first be produced by means of which the problem can be attacked, and I have devoted much thought to this subject. I am firmly convinced that it can be done, and hope that we shall live to see it done.

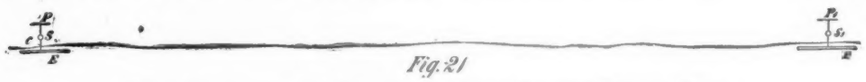

Fig. 21

TESLA LECTURE.—ENERGY TRANSMISSION TO ANY DISTANCE WITHOUT WIRES.

ON THE LIGHT PHENOMENA PRODUCED BY HIGH-FREQUENCY CURRENTS OF HIGH POTENTIAL, AND GENERAL REMARKS RELATING TO THE SUBJECT.

Returning now to the light effects which it has been the chief object to investigate, it is thought proper to divide these effects into four classes: 1. Incandescence of a solid. 2. Phosphorescence. 3. Incandescence or phosphorescence of a rarefied gas, and 4. Luminosity produced in a gas at ordinary pressure. The first question is, How are these luminous effects produced? In order to answer this question as satisfactorily as I am able to do in the light of accepted views and with the experience acquired, and to add some interest to this demonstration, I shall dwell here upon a feature which I consider of great importance, inasmuch as it promises, besides, to throw a better light upon the nature of most of the phenomena produced by high frequency electric currents. I have on other occasions pointed out the great importance of the presence of the rarefied gas, or atomic medium in general, around the conductor through which alternate currents of high frequency are passed, as regards the heating of the conductor by the currents. My experiments, described some time ago, have shown that the higher the frequency and potential difference of the currents, the more important becomes the rarefied gas in which the conductor is immersed, as a factor of the heating. The potential difference, however, is, as I then pointed out, a more important element than the frequency. When both of these are sufficiently high, the heating may be almost entirely due to the presence of the rarefied gas. The experiments to follow will show the importance of the rarefied gas, or, generally, of gas at ordinary or other pressure as regards the incandescence or other luminous effects produced by currents of this kind. I take two ordinary 50 volt 16 candle-power lamps which are in every respect alike, with the exception that one has been opened at the top and the air has filled the bulk, while the other is at the ordinary degree of exhaustion of commercial lamps. When I attach the lamp which has been exhausted to the terminal of the secondary of the coil, which I have already used in experiments illustrated in Fig. 15*a*, for instance, and turn on the current, the filament, as you have before seen, comes to high incandescence. When I attach the second lamp, which is filled with air, instead of the former, the filament still glows, but much less brightly. This experiment illustrates only in part the truth of the statements before made. The importance of the filament being immersed in rarefied gas is plainly noticeable, but not to such a degree as might be desirable. The reason is that the secondary of this coil is wound for low tension, having only 150 turns, and the potential difference at the terminals of the lamp is therefore small. Were I to take another coil with many more turns in the secondary, the effect would be increased, since it depends partially on the potential difference, as before remarked. But since the effect likewise depends on the frequency, it may be properly stated that it depends on the time rate of the variation of the potential difference. The greater this variation, the more important becomes the gas as an element of heating. I can produce a much greater rate of variation in another way, which besides has the advantage of doing away with the objections which might be made in the experiment just shown, even if both the lamps were connected in series or multiple arc to the coil, namely, that in consequence of the reactions existing between the primary and secondary coil the conclusions are rendered uncertain. This result I secure by charging from an ordinary transformer, which is fed from the alternating current supply station, a battery of condensers, and discharging the latter directly through a circuit of small self-induction, as before illustrated in Figs. 19*a*, 19*b*, 19*c*.

FIG. 23.

TESLA LECTURE. — CURIOUS INCANDESCENCE OF A WIRE.

In Figs. 22*a*, 22*b* and 22*c* the heavy copper bars B, B_1 are connected to the opposite coatings of a battery of condensers, or generally in such way that the high frequency or sudden discharges are made to traverse them. I connect first an ordinary 50-volt incandescent lamp to the bars by means of the clamps *c*, *c*. The discharges being passed through the lamp, the filament is rendered incandescent, though the current through it is very small, and would not be nearly sufficient to produce a visible effect under the conditions of ordinary use of the lamp. Instead of this I now attach to the bars another lamp exactly like the first, but with the seal broken off, the bulb being, therefore, filled with air at ordinary pressure. When the discharges are directed through the filament, as before, it does not become incandescent. But the result might still be attributed to one of the many possible reactions. I, therefore, connect both the lamps in multiple arc as illustrated in Fig. 22*a*. Passing the discharges through both the lamps, again the filament in the exhausted lamp *l* glows very brightly, while that in the non-exhausted lamp l_1 remains dark, as previously. But it should not be thought that the latter lamp is taking only a

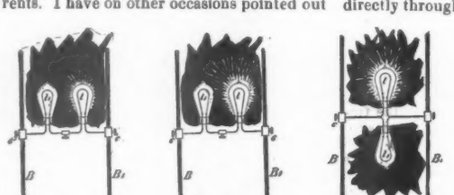

Fig. 22c *Fig. 22b* *Fig. 22a*

TESLA LECTURE.—SHOWING THE EFFECT OF THE PRESENCE OF A GASEOUS MEDIUM.

small fraction of the energy supplied to both the lamps; on the contrary, it may consume a considerable portion of the energy, and it may become even hotter than the one which burns brightly. In this experiment the potential difference at the terminals of the lamps varies in sign theoretically three to four million times a second. The ends of the filaments are correspondingly electrified, and the gas in the bulbs is violently agitated and a large portion of the supplied energy is thus converted into heat. In the non exhausted bulb, there being a few million times more gas molecules than in the exhausted one, the bombardment, which is most violent at the ends of the filament, in the neck of the bulb, consumes a large portion of the energy without producing any visible effect. The reason is that, there being many molecules, the bombardment is quantitatively considerable, but the individual impacts are not very violent, as the speeds of the molecules are comparatively small, owing to the small free path. In the exhausted bulb, on the contrary, the speeds are very great, and the individual impacts are violent, and, therefore, better adapted to produce a visible effect. Besides, the convection of heat is greater in the former bulb. In both the bulbs the current traversing the filaments is very small, incomparably smaller than that which they require on an ordinary low frequency current. The potential difference, however, at the ends of the filaments is very great, and might be possibly 20,000 volts or more, if the filaments were straight and their ends far apart. In the ordinary lamp a spark generally occurs between the ends of the filament or between the platinum wires outside before such a difference of potential can be reached.

It might be objected, in the experiment before shown, that, the lamps being in multiple arc, the exhausted lamp might take a much larger current, and that the effect observed might not be exactly attributable to the action of the gas in the bulbs. Such objections will lose much weight if I connect the lamps in series with the same result. When this is done, and the discharges are directed through the filaments, it is again noted that the filament in the non-exhausted bulb, l_1, remains dark, while that in the exhausted one, l, glows even more intensely than under its normal conditions of working, Fig. 22*b*. According to general ideas, the current through the filaments should now be the same, were it not modified by the presence of the gas around the filaments.

At this juncture I may point out another interesting feature, which illustrates the effect of the rate of change of potential of the currents. I will leave the two lamps connected in series to the bars B, B_1, as in the previous experiment, Fig. 22*b*, but will presently reduce considerably the frequency of the currents, which was excessive in the experiment just before shown. This I may do by inserting a self-induction coil in the path of the discharges, or by augmenting the capacity of the condensers. When I now pass these low-frequency discharges through the lamps, the exhausted lamp, l, again is as bright as before, but it is noted, also, that the non-exhausted lamp, l_1, glows, though not quite as intensely as the other. Reducing the current through the lamps, I may bring the filament in the latter lamp to redness, and, though the filament in the exhausted lamp, l, is bright, Fig. 22*c*, the degree of its incandescence is much smaller than in Fig. 22*b*, when the currents were of a much higher frequency.

In these experiments the gas acts in two opposite ways in determining the degree of the incandescence of the filaments—that is, by convection and bombardment. The higher the frequency and potential of the currents, the more important becomes the bombardment. The convection, on the contrary, should be the smaller, the higher the frequency. When the currents are steady, there is practically no bombardment, and convection may therefore with such currents also considerably modify the degree of incandescence and produce results similar to those just before shown. Thus, if two lamps exactly alike, one exhausted and one not exhausted, are connected in multiple arc or series to a direct current machine, the filament in the non-exhausted lamp will require a considerably greater current to be rendered incandescent. This result is entirely due to convection, and the effect is the more prominent, the thinner the filament. Prof. Ayrton and Mr. Kilgour some time ago published quantitative results concerning the thermal emissivity by radiation and convection, in which the effect of thin wires was clearly shown. This effect may be strikingly illustrated by preparing a number of small, short glass tubes, each containing through its axis the thinnest obtainable platinum wire. If these tubes be highly exhausted, a number of them may be connected in multiple arc to a direct current machine, and all of the wires may be kept at incandescence with a smaller current than that required to render incandescent a single one of the wires if the tube be not exhausted. Could the tubes be so highly exhausted that convection would be *nil*, then the relative amounts of heat given off by convection and radiation could be determined without the difficulties attending thermal quantitative measurements. If a source of electric impulses of high frequency and very high potential is employed, a still greater number of the tubes may be taken and the wires rendered incandescent by a current not capable of warming perceptibly a wire of the same size immersed in air at ordinary pressure, and conveying the energy to all of them.

I may here describe a result which is still more interesting, and to which I have been led by the observation of these phenomena. I noted that small differences in the density of the air produced a considerable difference in the degree of incandescence of the wires, and I thought that, since in a tube, through which a luminous discharge is passed, the gas is generally not of uniform density, a very thin wire contained in the tube might be rendered incandescent at certain places of smaller density of the gas, while it would remain dark at the places of greater density, where the convection would be greater and the bombardment less intense. Accordingly, a tube, t, was prepared, as illustrated in Fig 23, which contained through the middle a very fine platinum wire, w. The tube was exhausted to a moderate degree, and it was found that when it was attached to the terminal of a high frequency coil the platinum wire w would, indeed, become incandescent in patches, as illustrated in Fig. 23.

(To be continued.)

LITERARY.

"Journal of the Institution of Electrical Engineers" for June, 1893, has been received.

The catalogue of the University of Minnesota, of Minneapolis, Minnesota, for the year 1892–93 has been received. This volume, of over 250 pages, contains full accounts of the courses of studies for the University year following. The catalogue will be sent gratuitously, postage paid, to all persons who apply for it.

Dr. Robert Newman has sent us his valuable statistical paper on "The Present Status of Electrolysis in the Treatment of Urethral Strictures," containing brief statements of a third series of 100 cases, each operated on by the author. In this series but two cases proved failures under the electrolytic treatment, and these are candidly acknowledged. Sufficient reasons are given for these failures. The value of the electrolytic method is fully proved in this brochure, which we recommend to the careful attention of physicians.

"The Cyclopedic Review. Columbian Annual, 1892." Garretson, Cox & Company, Buffalo, N. Y.

This is one of the most valuable and interesting volumes that has come to us. It is designed to occupy an intermediate position between daily, weekly and monthly periodicals and the encyclopedias. It will be issued quarterly and will contain in concise form the history of the world up to date. The articles on electricity in the present volume, by Mr. Robert H. Read, one of the editors of the ELECTRICAL REVIEW, are thoroughly comprehensive and not too technical for the lay reader. We commend this book highly.

Taken as a whole, the "Book of the Fair," by Hubert Howe Bancroft, is probably the best presentation of the Columbian Exposition, historical and descriptive, which has been attempted. The plan is comprehensive, and yet not too extended, the aim being to give the Exposition entire in pictures and print, in 1,000 imperial folio pages, that is to say, 25 parts of 40 pages each. By taking the leading exhibits of a class as representative of the whole, giving the rest minor mention, to a greater or less extent, the entire round can be made, and yet the total result be a work not too cumbersome or expensive for the general public to handle and purchase.

The Oakland, Aurora and Terra Alta telephone line has been completed and is now in full operation. Oakland now has telephone connection with Mountain Lake Park, Deer Park, Eglon, Brookside, Aurora, Carmel, Painter's Mill and Terra Alta. It is proposed to extend the line to several other West Virginia towns in a short time. It will be a great convenience to summer visitors to have these various summer resorts connected by telephone with the telegraph office at Oakland.

A New Apparatus for the Demonstration of the Phenomena Produced by a Rotating Magnetic Field.

Dr. Weinhold has recently constructed a simple apparatus which is well adapted to demonstrate before a large audience the properties of a rotating magnetic field. The entire device is shown in Fig. 1, and Fig. 2 is a diagram of the connections. As the source of electricity, Dr. Weinhold employs a voltaic battery, whose continuous current he transforms by means of a commutator into sinusoidal currents. This rheostat consists of an endless circular steel wire laid in a groove. The current enters through the

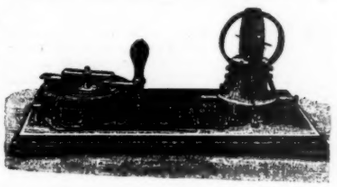

FIG. 1.—WEINHOLD'S DEVICE.

crank at two diametrically opposite points, while the crank, by means of two gliding contact plates, is connected with the poles of the battery.

Thus the current traverses the two halves of the rheostat coils in parallel, both the points of entrance and exit moving along the circumference. Now, by taking two distinct points at which the current enters (which points must be at the end of two rectangular diameters), the difference of potential between two corresponding points is a periodic time function, which, increasing to a positive maximum, falls to zero and then passing through a negative maximum again comes to zero. It should be noted, however, that this difference of potential is not represented by a sinusoidal curve, but by a series of straight lines, the maxima and minima being angular points. Again, these two periodic differences of potential, differing by a quarter phase, produce two separate rectangular magnetic fields, which together constitute the rotating field.

To show that a magnetic needle will turn in whatever direction the crank is moved, it is sufficient to connect the terminals of two rectangularly arranged coils to four points of the above mentioned steel wire. Instead of a magnetized needle we may pivot a

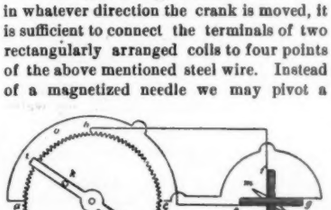

FIG. 2.—CONNECTIONS OF WEINHOLD'S APPARATUS.

copper or iron disk in the center of the coils, and, again, the two rectangularly arranged coils may be replaced by a few convolutions upon a regular Gramme ring. Fig. 3 shows four coils upon such a ring. Very similar apparatus may be used for tri-phased currents, but in this case there should be three distinct points of entrance for the current, 120 degrees from each other, and they must be connected to three coils whose axes make an angle of 120 degrees.

The Development of Dry Plates by Electricity.

Dr. Liesegang, of Düsseldorf, has combined two experiments made by Schützenberger in 1869 and Eider in 1886. He passes a dry current from six Gassmer dry cells through a concentrated solution of sodium sulphate; the zinc pole of the battery is coupled to a large platinum electrode in the outer vessel, and the positive pole is placed in a porous cell filled with the same solution. If a silver bromite plate which has had considerable exposure in the camera be placed in the vessel, a brownish red negative image is developed in a few minutes, the solution remaining quite clear. The inability of the combination has no effect in this electrolytic method, as it is constantly being produced afresh. The picture is weak and becomes even thinner in the fixing bath.

Press the Button.

[*From the Evening Sun.*]

The usual process of evolving electric energy is to light a coal fire under a steam boiler, and conduct the transformed water to a cylinder piston, which in turn revolves a dynamo. At Ottawa, Canada, an electric upright boiler is heated by electricity from a dynamo operated by a neighboring water power; the steam from this boiler drives an ordinary steam engine. At the same place a conservatory and a large retail establishment are heated from the same source of energy. These two installations were experimental, but after a winter's trial the local electric light, heat and power company is prepared to undertake similar installations generally.

At a recent woman's fair the water for making tea was heated electrically in decorative apparatus set on the table. At the same time an electrically heated baker's oven, fitted with a glass window, was set up, and that delighted artist was able to sell his buns at 25 cents the bun to the persons who watched them cook. The puffing of the dough under the measured and regulated 400 degrees of heat, and its gradual assumption of the tawny color characteristic of the bun are described as a process fascinating to view.

An Ottawa hotel recently served a dinner cooked by the electric apparatus, which in-

FIG. 3.—GRAMME RING EXPERIMENT.

cluded a 21-pound roast, several turkeys, ducks, lamb, etc. At Boston the other day an electric heating company gave a dinner which embraced fish fried, steak broiled, beef roasted, potatoes boiled and bread baked at an electric cooking range. The absence of a chimney and other accessories, the fact that only the closing of a switch was necessary to obtain heat which might be continued indefinitely and shut off instantaneously without dirt, dust or labor, appealed vehemently to the householders present. The time occupied in preparing the meal is 30 minutes less than is usually required to do the same work on a hotel range.

The rapid progress making with these domestic installations in England has been recently noted. There the electric and the gas companies are driving one another hard to secure the market. Cooking apparatus of both sorts is supplied at prices which are already low. Both sources of heat are derived from coal, the one by its combustion under a steam boiler, the other by its destructive distillation in a retort, yet it is found possible to deliver the product at a price that competes with the raw material consumed in a cooking stove. This fact diminishes the significance of the Ottawa installations deriving their energy from the

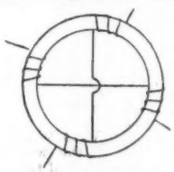

FIG. 4.—DIAGRAM OF GRAMME RING.

gravity of falling water. The ELECTRICAL REVIEW recently printed wood cuts of coffee and tea urns, plate stoves and the electric cooking range with its attached boiler. The outward appearance of the last is much that of the familiar kitchen range.

In several mechanical directions the use of electricity is expanding at a rate which can be temperately described as by leaps and bounds. Its domestic use, however, seems laden with a blessing to the world's women beyond any other which it can subserve. Neither is that day so far off as it seemed only a few months ago. The introduction of electric cooking may be deferred in some of the greater American cities, but the smaller ones whose vested interests are less dominant may be expected to follow up the lead of Ottawa. It must be borne in mind that so obvious an improvement as the street cable was a generation old before it was able to gain a footing in New York, Philadelphia or Baltimore. But after the West shall have discarded the hot laborious cooking stove and heating furnace, the women of our older cities may hail with a great thankfulness the coming boon, if not to themselves at least to their daughters.

Electro-Chemical Effects Due to Magnetization.

BY GEORGE OWEN SQUIER, PH. D., LIEUT. U. S. ARMY, IN THE "AMERICAN JOURNAL OF SCIENCE."

INTRODUCTION.

The influence of magnetism on chemical action was the subject of experiment by numerous investigators during the first half of the present century. Up to 1847, we find by no means a uniformity of statement in regard to this subject, and secondary effects were often interpreted as a true chemical influence. Among the earlier writers who maintained that such an influence exists, may be mentioned Ritter, Schweigger, Dobreiner, Fresnel and Ampère, while those of opposite view were Wartmann, Otto-Lluné Erdmann, Berzelius, Robert Hunt and the Chevalier Nobili.

Professor Remsen's discovery in 1881, of the remarkable influence of magnetism on the deposition of copper from one of its solutions on an iron plate, again attracted to the subject, and since then considerable work has been done directly or indirectly bearing on the question.

Among other experiments by Professor Remsen were the action in the magnetic field of copper on zinc, silver on zinc, copper on tin, and silver on iron, in all of which cases the magnet evidently exerted some influence. With copper sulphate on an iron plate the effects were best exhibited, the copper being deposited in lines approximating to the equipotential lines of the magnet, and the outlines of the poles being distinctly marked by the absence of deposit.

Messrs. Nichols and Franklin were the next to conduct experiments bearing on this subject. They found that finely divided iron, which has become "passive" through the action of strong nitric acid, suddenly regains its activity when introducted in a magnetic field, and also that when one of the two electrodes immersed in any liquid capable of chemically acting upon them is placed in a magnetic field, a new difference of potential is developed between them due to this magnetization. They ascribe these effects to electric currents in the liquid produced indirectly by the magnet, which currents go in the liquid from the magnetized to the neutral electrode.

Professor Rowland and Dr. Louis Bell were the first to note the "protective action" of points and ends of magnetic electrodes, and to give the exact mathematical theory of this action. Their results were directly opposite to those of Messrs. Nichols and Franklin, who found, as stated above, that points and ends of bars in a magnetic field acted like zincs to the other portions, or were more easily dissolved by the liquid.

The method of experiment adopted by Professor Rowland was to expose portions of bars of the magnetic metals placed in a magnetic field to reagents which would act upon them chemically, and study the changes in the electro-chemical nature of the exposed parts by fluctuations in a delicate galvanometer connected with the two bars. Iron, nickel and cobalt were experimented upon and nearly thirty reagents were examined in this manner. The results are summed up in the following statement: "When the magnetic metals are exposed to chemical action in a magnetic field, such action is decreased or arrested at any points where the rate of variation of the square of the magnetic force tends towards a maximum."

Other investigations in this field are those of Andrews, who employed iron and steel bars from eight to ten inches long with their ends immersed in various solutions, and one bar magnetized by means of a solenoid. The protective action was not noted, but, on the contrary, the magnetized bars acted as zincs to the neutral bars, thus indicating that they were more easily attacked.

Practically the same results were obtained by Dr. Theodor Gross; soft iron wires 8cm. long, and 3 cm. in diameter, coated with sealing wax, except at the ends, were exposed to various liquids. When one electrode was magnetized a current was obtained going in the liquid from the magnetized electrode to the non-magnetized electrode.

It thus appears that there is at least an apparent inconsistency between the protective results of Professor Rowland and Professor Remsen, and those of Nichols, Andrews, Gross and others, who find the more strongly magnetized parts of iron electrodes more easily attacked than the neutral parts, and it was with the object of endeavoring to reconcile these results and of studying the exact nature of the influence exerted by the magnet, that the experiments recorded in this paper were undertaken.

APPARATUS AND METHOD OF INVESTIGATION.

The method of investigation was that adopted by Professor Rowland in his previous work on the subject, since its facility and delicacy permitted the effects of the magnet to be observed whenever there was the slightest action on the electrodes by the solution examined, and the investigation could thus be carried over a wide range of material.

A large electromagnet was employed to furnish the magnetic field, and, at a distance sufficient to prevent any direct influence due to the magnet, a delicate galvanometer of the Rowland type was set up. Small cells were made of iron electrodes of special forms, coated with sealing wax, except at certain parts, and immersed in a liquid capable of acting chemically on iron. The whole was contained in a 50 cc. glass beaker, and when joined to the connecting wires of the distant galvanometer was firmly clamped between the poles of the electro-magnet.

In the course of the examination of a number of substances it was found necessary to use two galvanometers, one specially made by the University instrument maker and very sensitive, which was employed with acids which evolve hydrogen; the other much less sensitive was best suited to the violent "throws" with nitric acid and iron. The samples of iron used throughout the experiments were obtained from Carnegie, Phipps & Company, of Pittsburgh, and were practically pure.

In order to insure a uniform density of surface, the electrodes were turned from the same piece and polished equally with fine emery cloth. The magnet could be made or reversed at the galvanometer, and its strength varied at will by a non-inductive resistance. The electro-chemical effects due to the magnetic field could thus be studied with facility by the fluctuations of the galvanometer needle. The original difference of potential which always existed between the electrodes was compensated by a fraction of a Daniell cell, so the effects of a variation of the magnetic field could be observed when no original current was passing between the electrodes.

The standard cells were made with care, and under uniform treatment possessed at 20° C. an electromotive force of 1.105 volts. The connections with the compensating circuit, which contained a finely divided bridge, were so arranged that from its readings the difference of potential between the distant electrodes became known at once without involving the resistance of the cell or of the galvanometer.

Since quantitative measurements of the effects observed were desired, a preliminary step was to calibrate the electro-magnet for a given distance apart of the pole-pieces. The method employed was the well-known one of comparing the galvanometer deflections produced by a test-coil in the field with those of an earth inductor in series in the circuit. Since the effect of the sudden addition of a certain strength of field was wanted instead of its absolute value, the deflections with the test-coil were taken for simple "make" or "break" and not for reversed field, thus eliminating the residual magnetism of the pole-pieces.

In the formula applicable, viz.: $\frac{H}{H'} \frac{\pi n a^2}{\pi n' a'^2}$

$= \frac{d}{d'}$ nearly, in which d and d' represent the deflections due to the inductor and test-coil respectively; H and H' the earth's field and the field to be measured; n and n' the number of turns; and a and a' the radii of the coils, the particular values were

$$\pi n a^2 = 20716 \text{ sq. cm.}$$
$$\pi n' a'^2 = 6.788 \text{ sq. cm.}$$
$$d = 4.697$$

Distance between pole-pieces 3.5 cm.

$H' = 1299.48\ d'H$, and as d' varied from $\frac{1}{16}$ to 16, the range of field employed was from 65 to 20,800 H.

A curve was constructed so that from accurate ammeter readings in the field circuit, the strength in absolute measure could be read off at once.

EXPERIMENTAL RESULTS.

Preliminary.—The first experiments were made with very dilute nitric acid and iron electrodes, one a circular disc of 5 mm. radius, and the other a small wire 1 cm. long and 1 mm. in diameter turned to a sharp point at one end. The point was placed opposite the center of the disc, at a distance of 1 cm. from it, and the whole placed so that the cylindrical electrode coincided with the direction of the lines of force. When the minute point and the center of the disc were exposed to the liquid, and the magnet excited, a momentary "throw" of the galvanometer was observed in the direction indicating the point as being protected or acting as the copper of the cell.

When the pointed pole was slightly flattened at the end, and the insulation so cut away that the surfaces of exposure on the two electrodes were exactly the same, the throw of the galvanometer on making the field was very much diminished, although still perceptible, since the disposition of lines of force would still be very different over the two plane surfaces of exposure.

With ball and point electrodes precisely similar phenomena were observed as with a disc and point, except to a less degree.

The gradual reversal of the current shortly after exciting the field; the independence of the throw of the direction of the current through the magnet; the disappearance of the throw when the nature of the magnetic field at the exposed parts became the same, and the effects of artificially stirring the liquid were observed exactly as described by Messrs. Rowland and Bell.

In the course of a large number of preliminary experiments with nitric acid it was soon observed that under certain conditions the effect of suddenly putting on the magnetic field was to produce a less rapid deflection of the galvanometer in the opposite direction, or indicating the point as acting as a zinc. Plainly this irregular behavior, due to the magnet, required a more systematic study than it had yet received. It had been found that the reversal of the current which regularly followed the "protective throw" was decreased or destroyed by anything which prevented free circulation in the liquid, and that an acidulated gelatine, which was allowed to harden around the poles, was best suited for this purpose. The great irregularity observed in any one experiment made it necessary to eliminate everything possible which might mask the true phenomenon, if any accurate comparisons were to be drawn between the effects observed in the different cases. Accordingly a standard form of experiment was adopted, which was carefully repeated many times. The cell found best suited for this purpose was composed as follows:

Disc electrode, diameter	14.4 mm.
thickness	2.6 mm.
Point electrode, total length	15.2 mm.
diameter	4.4 mm.
length of point	5.2 mm.
Distance of point from center of disc	10. mm.

The same electrodes were used throughout any set of experiments, being carefully cleaned and polished each time.

With nitric acid the liquid was finally made up as follows:

Distilled water	10 grams
Hard gelatine	1 gram
C. P. nitric acid (sp. gravity, 1.415)	0.533 grams

The gelatine and water were allowed to stand until the former had dissolved without the application of heat, when the acid was added and the whole thoroughly mixed. Too strongly acidulated gelatine would not harden at all.

In some cases, in order to protect the point from the *beginning*, the electrodes, secured as usual at the ends of two small glass tubes containing the connecting wires, were firmly clamped in the proper position between the poles of the magnet, and the magnetic field put on before the cell was completed by pushing the beaker containing the solution up in position around the electrodes.

With this cell a series of parallel experiments were conducted to obtain the variation of the effects with time, or the amount of iron salts present, the fluidity of the solution, and with constant and variable magnetic fields.

A.—BEHAVIOR OF THE CELL WITH TIME, IN THE EARTH'S FIELD.

The cell was placed entirely outside the magnetic field, and galvanometer readings taken at intervals of one minute for three hours. The curve Fig. 1 (I) shows these results. Positive ordinates indicate a current from the point to the disc and negative ordinates the reverse current. Other experiments with fresh solutions, same electrodes, same exposed area and every condition as nearly as possible the same gave curves of practically the same character, and the one given is selected to illustrate.

The curve indicates that the original current was to the point electrode; this gradually decreased, due to polarization, until after an hour and five minutes it reversed slightly, but again reversed 35 minutes later, and after a little more than two hours the deflection became perfectly constant, remaining so indefinitely.

The iron salts formed could not move with facility from the exposed surfaces through the hardened gelatine, and were easily outlined from their brown color, as the whole apparatus was placed in a strong light.

B.—IN A UNIFORM MAGNETIC FIELD.

The cell was next placed in the magnetic field, which was kept practically uniform (about 15,650 H.) for three hours, and galvanometer readings taken as before.

The electrodes were magnetized before being introduced into the solution, so as to protect the point from the beginning. In order to prevent the influence of the rise of temperature due to the heating of the field coils of the electro-magnet, the whole cell was packed with cotton wool between the poles. As Gross and Andrews observed, the temperature effect was small, the solution rising but 0.7° C. in half an hour.

The curve Fig. 1 (II) shows the result of these observations. It is seen that the original current was as before to the point electrode, and about the same in value. This reversed after 45 minutes, and rapidly increased to approximately twice its original value at the end of one hour and 20 minutes, and instead of again reversing, remained indefinitely with the point electrode as a zinc. The distribution of the iron salts in this case is quite unlike the former. Notwithstanding the gelatine, the powerful magnetization of the exposed point gradually drew the iron salts from the disc as fast as they were formed, and concentrated them symmetrically about the point, giving the solution in this region an almost black appearance.

After waiting a sufficient time to be assured that further presence of iron salts would not affect the permanency of the existing electromotive force, the magnetic field was gradually decreased without ever breaking circuit, by increasing the liquid resistance in the field current. This change of resistance was necessarily made more or less suddenly, and the deflection experienced at each increase of resistance, a not very sudden throw toward reversal, in every respect the same as had been repeatedly observed in the preliminary experiments, and very different from the characteristic "protective throw," which is always sudden and in one direction.

By simply varying the field current with care, as explained above, the deflection could be reversed again and again at will, and could also be held at the zero of the scale indicating no current at all, as long as desired. When once the field was entirely broken the iron salts were released from the control of the exposed pole, seriously disturbed by gravity, and putting on the field again failed to reproduce the results noted above.

The only elements of difference in the two cases are, (*a*) the magnetized condition of the metal, (*b*) the distribution of the iron salts formed by the reaction.

Although, as the curves indicate, the average electromotive force with the magnetic field was much greater than in the former case, yet this electromotive force is due to the difference of action at the two exposed surfaces, and, as will be pointed out later, the total amount of iron dissolved and passing into solution in the two cases is probably not very different. Quantitative experiments are wanting on this point.

The influence of the magnetized condition of the metal and its magnitude is exhibited in the phenomenon of the "protective throw," which is always observed with apparatus sufficiently delicate, unless it is masked by other secondary phenomena.

Since the electrodes were embedded in hardened gelatine, there could be no convection currents in the liquid, and this can be eliminated. Evidently the great difference in the behavior of the cell in the two experiments described is principally due, either directly or indirectly, to the distribution of the iron salts formed by the reaction in the two cases.

The principal time effects of the magnet were:

(*a*) To produce a higher potential at the point of greater magnetization.

(*b*) To increase the rate of change of the potential between the electrodes and the absolute value of this potential difference.

(*c*) It also appears from both curves that after a certain distribution of iron salts is reached, further presence of the same does not affect the permanency of the current established.

Since the time effects of the magnet were so marked, it was thought possible that a "cumulative" effect, due to the Earth's field alone might be detected after a sufficient time had elapsed. The apparatus was made as delicate as possible, and parallel experiments conducted, the electrodes first being placed in the magnetic meridian, and afterwards perpendicular thereto. No positive difference could be detected.

C.—CONVECTION CURRENTS IN THE LIQUIDS.

As has already been stated, the reversal of the current which regularly followed the "protective throw" was found by Messrs. Rowland and Bell to wholly disappear when hardened acidulated gelatine was substituted for the dilute acid solution, so that when the magnet was put on, a permanent deflection of much less magnitude was obtained instead of a transitory throw. This indicated that currents in the liquid cannot be neglected, and their study was next undertaken. Since hardened gelatine completely prevented the reversal of the current, and with no gelatine it regularly appeared after short time, a large number of experiments were made, in which the amount of gelatine was varied continuously between these limits. As expected, the effects also varied, the greater the fluidity of the solution, the more quickly the reversal occurred.

In the light of what was already known concerning the presence of iron salts, some of the experiments were continued over a considerable time, and in others iron salts were introduced artificially, to increase the effects. It was soon found that by starting with a fresh hardened gelatine, with which the "protective throw" was the only feature, and gradually increasing the fluidity of the solution and the amount of iron salts present, both effects were exhibited at the making of the field; first, the sudden throw of the needle always in the direction to protect the the point, and immediately thereafter the

comparatively slow "concentration throw" in the opposite direction. By making the conditions still more unfavorable for the "protective throw" it gradually diminished until entirely masked by the second effect, so that making the field produced a deflection in the direction indicating a current from the point.

With the proper conditions both of these effects could be studied with the greatest ease: First, one made prominent, then both equal, then the other prominent at will. The "protective throw" could be traced until it became a mere stationary tremor of the needle at the instant of its starting on the "concentration throw." This latter, though called a "throw," can be made to vary from an extremely slow continuous movement of the galvanometer deflection, as in experiment *B*, already described, to a comparatively rapid deflection at the instant of making the magnet.

By using simply a dilute nitric acid solution with no gelatine, and inserting a thick piece of glass between the electrodes, the concentration effect was delayed enough to allow the "protective throw" to first appear, with considerable iron salts in the solution, and on making the field both effects were observed as described above.

It now appears that the reversal of the current uniformly observed in the experiments of Messrs. Rowland and Bell was but a form of the "concentration throw" mentioned above, and that we can regard the substitution of the hardened acidulated gelatine for the dilute acid as merely separating these effects, so that the former can be studied by itself. In other words, the reversal of the current would have occurred just the same after a sufficient time had elapsed.

Turning to the experiments of Drs. Gross and Andrews, they employed but one magnetized electrode, which was not pointed. In this case the nature of the magnetic field at the two exposed surfaces would be very much more nearly the same than when a pointed electrode is employed. This arrangement is not, therefore, suited to bring out the delicate "protective throw," and it is not surprising that the concentration effect was the prominent feature observed.

We have now a complete reconciliation of the directly opposite results referred to in the introduction. The "protective throw" is due to the actual attraction of the magnet for the iron, and is always in the direction to protect the more strongly magnetized parts, while the "concentration throw" is always in the opposite direction, and depends upon the distribution of the iron salts present in the solution, and the convection currents in the liquid. The concentration of the products of the reaction about the point would tend to produce a ferrous reaction instead of a ferric reaction, and experiment shows that a higher electromotive force is obtained with cells in which a ferrous reaction takes place than with those in which a ferric reaction occurs, and this change in the character of the reaction produced by the concentration probably accounts, at least in part, for the increased electromotive force at the point.

D.—THE IRON SALTS ABOUT THE POINT ELECTRODE.

The effect of artificially stirring the liquid, and the direct influence of the fluid condition of the solution on the deflections observed, at once suggested movements of the liquid, produced indirectly by the magnet. In order to locate these currents, and determine their potence, a small cell was made of two rectangular pieces of glass, held by stout rubber bands to thick rubber sides. Perforations in the sides admitted the electrodes, which were point and disc as before. The cell, between the poles of the electro-magnet, was in a strong light, and the movements in the liquid were easily perceptible from the displacements of suspended particles introduced for the purpose. When very dilute nitric acid was placed in the cell, and the magnet excited, some interesting phenomena were observed.

The liquid, at first colorless, almost immediately assumed a pale brown color about the point, but nothing appeared at the disc electrode. The iron salts were drawn as soon as formed towards the point electrode, since here the rate of variation of the square of the magnetic force is a maximum.

As more iron was dissolved, a surface approximating to an equipotential surface of the pointed pole, and enveloping the colored iron salts, was observed enclosing the point, and at some distance from it. The outline of the surface became darker in a short time, and finally two or more dark contours, separated by lighter portions and symmetrical with the outer one, appeared between it and the point, indicating maxima and minima of density. When the magnetic field was gradually increased, this surface usually enlarged without breaking up and holding the iron salts within it. On further strengthening the magnetic field to about 16,000 H the ridges merged into one thick black envelope around the point.

This phenomenon is best studied with but little iron salts present, and by watching the point electrode with a microscope while the strength of the magnetic field is increased and decreased continuously. The sections, Fig. 3, show the general form of these contours with different strengths of field.

Upon breaking the field, everything dropped from the point suddenly to the bottom of the cell, and, on making the field again, it required a few seconds for the salts to reappear at the point. This, at least, partially accounted for the sudden effects often noticed at breaking the field circuit, and the comparatively small ones at "make," especially with certain salt solutions, such as copper sulphate.

The outer envelope, which held the iron salts together, and limited the immediate influence of the magnetized point, was distinctly defined within the liquid, and easily observed by the reflection of the light from its convex surface.

The persistency with which the iron salts were held about the point was shown by moving the cell with respect to the electrodes, when the contour remained approximately intact, passing bodily through the liquid without being broken up.

E.—ELECTRO-MAGNETIC ROTATIONS.

The small dust particles present in the liquid were drawn radially toward the point until they reached the surface described, when they pierced it and began to revolve rapidly about the point inside this surface, in the opposite direction to the currents of Ampère. Reversing the poles of the magnet produced surfaces of the same appearance, but opposite rotations.

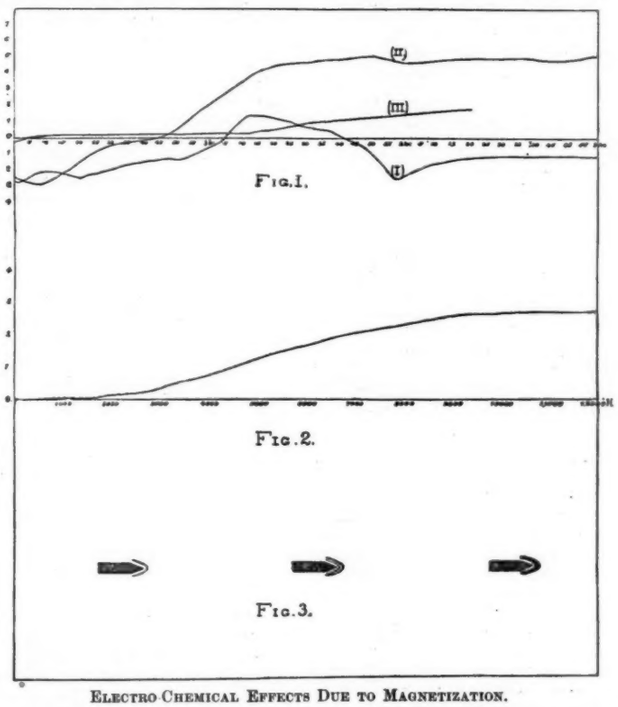

FIG. 1.

FIG. 2.

FIG. 3.

ELECTRO-CHEMICAL EFFECTS DUE TO MAGNETIZATION.

When the current from a Daniell cell was sent through, it seemed to have very little effect upon the rotations, showing them to be controlled by the powerfully magnetized point.

The electro magnet was arranged with its field vertical, and the point electrode along the lines of force as before. This arrangement gave better control of the surfaces formed, since gravity now acted symmetrically about the point.

When a single iron rod about 3mm. in diameter, and placed vertically in the cell, was substituted for the two electrodes, two rotations were observed, which were uniformly dextro about the north-seeking pole of the rod, and lævo about the south-seeking pole. About the central neutral portion no rotations were observed. When the rod was covered with a thin coating of vaseline, the rotations entirely disappeared as expected. Wartmann observed similar rotations about soft iron cylinders adhered to the poles of a magnet, and he ascribed them to electric currents in the liquid which proceed from the periphery of the cell radially to the surface of the rod.

The explanation of these rotations follows at once from what we know of the time effects produced by the magnet. A higher potential is always produced at points of greater magnetization, causing electric currents in the liquid from the more strongly magnetized to the weaker parts of the iron.

Applying this fact to the exposed conical point electrode, we see that local electric currents exist from its vortex to the other parts of the surface, returning by way of the metal. In the case of the vertical rod, these currents pass from the poles at its ends, through the liquid, to the neutral portions, returning as before.

These currents, under the influence of the poles, would cause electro-magnetic rotations of the liquid, as we find them. The mere mechanical influence of these rotations, as in the case when the liquid is artificially stirred, is to increase the chemical action upon the point, causing it to tend to act more like a zinc.

F.—ACIDS WHICH ATTACK IRON WITH THE EVOLUTION OF HYDROGEN.

Professor Rowland had observed the "protective throw" with such acids to be extremely small and difficult to detect, except by very sensitive apparatus. The sensitive galvanometer was set up, and every precaution taken against inductive effects. A telescope and scale were used in this part of the work.

Several substances were first examined, among them being hydrochloric acid, acetic acid, perchloric acid, chlorine water, copper sulphate, ferric chloride, sulphuric acid, etc., but as these observations added nothing to the results already obtained, they are not given here.

After several trials, a standard sulphuric acid solution was made up as follows:

Distilled water	10 grams
Gelatine	1 gram
C. P. Sulph. acid (sp. gravity 1.826)	1.062 grams

More strongly acidulated gelatine would not harden, and weaker solutions gave too small effects.

The "protective throw" was detected, but the point very soon became completely covered with minute bubbles of hydrogen, so that the electrodes had to be cleaned constantly.

The effect of adding hydrogen dioxide to the solution was next tried, since this would facilitate the removal of the hydrogen as soon as formed, which was thought to act merely mechanically.

When about 1cc. of H_2O_2 was added to the solution, the "protective throw" became much more prominent, and the gas bubbles only appeared in small quantities after a considerable time; further addition of small quantities of the dioxide showed the "protective throw" to be very decided with sulphuric acid when the hydrogen is removed from the surface of the electrodes in this manner.

G.—THE ELECTROMOTIVE FORCE.

Several attempts were made to obtain the relation between the strength of field and the electromotive force developed in the "protective throw," but it was difficult to obtain consistent readings, owing to the trouble of balancing the original deflection, and the small absolute values of this electromotive force when hardened gelatine was employed.

A curve was constructed, however, showing the variation of the galvanometer deflection with the strength of field, using nitric acid solution without gelatine. This is shown in Fig. 2.

The readings were taken one after another as rapidly as possible, to eliminate the damping effects of the iron salts formed.

The curve exhibits the general character of the variation. In the region from about 3,500 H to 8,000 H the greatest rate of change occurred, and beyond 10,000 H the curve became nearly horizontal for the particular electrodes used. Curves were also constructed for the "concentration throw" on making the field under different conditions, and they were approximately right lines more or less inclined, according to the amount of iron salts present.

With the sulphuric acid solution already given, the electromotive force varied from 0.0033 to 0.078 of a volt, while with the nitric acid solution it became as great as 0.036 of a volt. In making all the solutions used with the different substances, amounts were taken proportional to their particular molecular weights, and then halved or doubled until of a suitable strength to give results with the galvanometer. It was thought possible at the beginning that this might lead to some relations between the protective results and the strengths of the particular solutions, but the general irregular character of the whole phenomenon prevented comparisons in this respect, and all that can be stated is, that both the "protective throw" and the concentration effect, in general, increased rapidly with the strength of the solution.

H.—INFLUENCE OF A PERIODIC MAGNETIC FIELD UPON THE CELL.

An experiment was made to determine the behavior of the standard nitric acid cell when the magnetic field was made and broken at regular intervals over a considerable time, and curves were drawn showing the variation of the "throw" with time and the fluctuation of the original deflection caused by this treatment. The strength of field was about 11,000 H, and the experiment was conducted without compensating the original deflection, and by making the field for one minute, then breaking for one minute, and so on.

One of the curves is shown in Fig. 1 (III), in which positive ordinates are values of the concentration throw at "make" and negative ordinates the values of the "protective throw."

Experimenting was not begun until the gelatine had completely hardened, and, since the electrodes would tend to become polarized while the gelatine was hardening, the "protective throw" was very small, and soon masked by the concentration effects. After about five minutes, making the field had very little effect at all, but began to show decided "concentration throws" ten minutes later, and these rapidly increased with time, as the curve indicates.

Considering the fluctuation of the original deflection, the effect of this periodic field was to tend to reverse it, just as in the case of the uniform field in experiment B, but much more slowly, since the field was on but half the time in this case.

The cell also showed the iron salts almost entirely about the point, forming a thick, black envelope.

I. Summary.—The principal results of this investigation may be summarized as follows:

Whenever iron is exposed to chemical action in a magnetic field, there are two directly opposite influences exerted.

(*a*) The direct influence of the magnetized condition of the metal, causing the more strongly magnetized parts to be protected from chemical action.

This is exhibited in the phenomenon of the "protective throw," which is always in the direction to protect the more strongly magnetized parts of magnetic electrodes. The "protective throw" is small, often requiring delicate apparatus to detect it, and is soon masked by the secondary concentration effects.

As to the absence of the "protective throw" with acids which attack iron with the evolution of hydrogen, the hydrogen acts merely mechanically, and when removed by adding to the solution small quantities of hydrogen dioxide, the "protective throw" becomes very decided.

In the curve, Fig. 2, representing the variations of the "protective throw" with the strength of the magnetic field, we trace at once the magnetization of the point electrode. Since only the minute point was exposed to the liquid, it would become saturated for comparatively small magnetizing forces, and the curve indicates that this occurred at about 10,000 H, beyond which the curve becomes practically horizontal. This further establishes the direct connection between this "throw" and the variation of the magnetization of the exposed point, and confirms the explanation of Professor Rowland, that it is due to the actual attraction of the magnet for iron, and not to any molecular change produced by magnetization.

(*b*) The indirect influence of the magnet caused by the concentration of the products of the reaction about the more strongly magnetized parts of the iron.

This tends to produce a higher potential at the more strongly magnetized parts, and finally establishes permanent electric currents, which go in the liquid from the more

(*Continued on page 246.*)

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ASSOCIATE EDITORS:
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ROBERT H. READ.

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Some time ago the ELECTRICAL REVIEW advised its readers to visit the World's Fair before July 1 and avoid the crowds expected by that time. Our prediction is being rapidly verified, as the daily attendance is closely approaching the 200,000 mark.

The great telephone exchange of this city has been thrown from its pinnacle of greatness. Chicago is the conqueror and she now posesses the largest exchange in America. The new directories which were issued last week show that nearly 10,000 lines are now in operation in that city. This is about 700 more than New York can boast of.

The invitations to the International Electrical Congress, which will be held in the Art Palace, at the foot of Adams street, Chicago, from August 21 to August 25, inclusive, have been issued. A programme of the congress is published on another page. There have been several electrical congresses in the past, each of which has accomplished good. But this one will overtop them all in point of attendance and in the importance of its deliberations. It promises, too, to be of a fairly representative international character, which is a source of good in itself. We urge upon every electrical engineer the importance of his attendance at this congress.

A WELL DESERVED HONOR.

Tuft's College, of Massachusetts, on the occasion of its commencement exercises June 21, conferred upon Mr. C. J. H. Woodbury, vice-president of the Boston Manufacturers' Mutual Fire Insurance Company, the honorary degree of Master of Arts. Mr. Woodbury has been for many years actively engaged as an engineer and scientist upon matters pertaining to the application of science on behalf of companies insuring manufacturing property. It was in connection with this work, in which he has been a pioneer, that the recognition was given.

ELECTRIC LIGHTING OF TRAINS.

Anyone who is obliged to travel, daily or nightly, through the Fourth avenue tunnel has felt the necessity for train lighting which will afford at least some little degree of comfort. Even in the parlor cars the light is proverbially bad, which has led in a very slight degree to the installation of what might be called individual isolated plants consisting of a storage battery, often a leaky one, and a small incandescent lamp. The whole outfit is a nuisance, and one would prefer do to without reading than carry the apparatus. Let us have the electric lights, and plenty of them in the cars. The conservatives should be goaded with a sharp stick to make them realize the advantages which good electric illumination would furnish to themselves, and incidentally to their patrons.

ONE HUNDRED MILES AN HOUR.

It will be remembered that the towns of Brussels and Antwerp intend to each hold an international exhibition in 1895, each claiming the right to do so, and that partly in connection with them and partly to afford a rapid means of transit between the two places, a scheme has been prepared for the construction of an electric railway to connect the two towns, which are separated from each other by about 25 miles.

M. Flamache (of the Belgian State railways) who recently described the projected railway, stated that it would form almost a direct line between Brussels and Antwerp, leaving Malines three miles to the east. The curves would be insignificant and there would be few places where the line would cross the ground level, the level to be avoided as much as possible so as to obviate the necessity for slowing down the trains, which are proposed to run at about 110 miles an hour!

According to M. M. de Rudder and van Bogaert, State railway engineers at Antwerp, the cost of constructing the projected railway would be £760,000, supplementary works increasing this amount to £920,000. Each train would consist of either one or two carriages with seats arranged longitudinally.

At present the scheme exists on paper only, and until the necessity for the proposed railway is shown, the question of obtaining a concession for its construction will hardly be seriously considered, leaving the very high speed suggested out of consideration.

ELECTRICAL TERMS AND SLANG.

Another electrical phrase has been transferred from technical service to the broader and more popular realm of slang usage. The ELECTRICAL REVIEW several months ago called attention to the expression "Your trolley's off," which has come to be the latest equivalent for "You're off your base." And now the simple phase "live wire" has become slang.

To the electrician "live wire" means nothing more than a wire charged with a current of electricity, or through which current is flowing. The aptitude with which this phrase adapts itself to a slang meaning is well shown in the remark which a member of the Lotos Club uttered in reference to a Russian drink:

"Vodka is *live wire* when you don't know how to drink it, and when you do it is comparatively tame."

In this sense we have a new substitute for "hot stuff," "Jersey lightning," etc. Conversely, "dead wire" might refer to a comparatively insipid drink, such as lemonade or apollinaris. A poor play, an untuneful concert, a dull book, may be criticised as "dead wire." An absorbing play, a tuneful concert, an interesting book are "live wire."

And so we move on. Science, and especially electrical science, is almost daily called upon to assist man in his progress, even unto furnishing him with expressive slang epithets. While the latter service is not an ultra ideal one, yet the electrician is altruistic enough to furnish a portion of the world's slang, and in this work, as in everything else, he will be found to be "live wire."

LETTERS FROM A LABORATORY.—LI.

BY JULIAN A. MOSES.

In experimenting, dispatch is not of so much consequence as accuracy. In many cases these two qualities should go hand in hand, but in experimenting, where the time element does not enter so much into consideration, accuracy should predominate. In preliminary work principally dispatch is often a matter of necessity, for the eagerness for the desired end makes time lag and produces attempts instead of results. Speed therefore in the beginning is a help to the experimenter and a combination of speed with accuracy gives results which are as satisfactory from the manipulator's standpoint as could be desired. Accuracy embraces those qualities, such as thoroughness and perfection of mechanical detail, while dispatch allows of the successful accomplishment of the processes in hand.

Pieces of apparatus used for augmenting speed and which might be called "accelerators" or labor saving devices are always welcomed by the worker. Those supplanting machines which save the labor of one and require the attendance of two are, it is true, labor saving—to the laborer, but they should not be classed under this head.

I once asked a well known designer of machines what was the secret of his uniform success.

"I never let a machine go out of my shop," said he, "unless I am thoroughly satisfied that all parts are as perfect as I can make them. In a perfected machine the details should take care of themselves, for the old saw, 'Take care of the pence and the pounds will take care of themselves,' may be applied in the case of machine designing."

A very ingenious "accelerator," a device for rapid weighing, which has recently been reinvented in a laboratory where the operators have had occasion to do much rapid weighing may, perhaps, be useful to those who are similarly situated. It is a simple attachment which may be applied very readily to chemical balances, and is constructed as follows:

Immediately over the right hand scale pan, into which, for the sake of convenience, the weights are generally placed, in the top of the balance case is bored a hole through which should slide a brass rod of such a length that when sufficiently depressed one end should reach the scale pan and the other end project about one inch above the top of the case.

This rod should slide freely and have soldered to its lower end a small brass hook to which must be attached a chain of gold, phosphor-bronze or aluminum, the metal of which it is made being chosen as the experimenter may see fit. If it is possible this chain should be so selected as to contain about 100 links and weigh about 10 grams. It will, perhaps, be difficult to obtain such a chain, but if one weighing nearly 10 grams is obtained, and it happens that the weight is in excess of that number of grams it may be uniformly reduced by dipping it into a nitric acid solution carefully drying before reweighing.

It is not necessary, however, for the chain to be of any definite weight, for the rod holding it may have graduated upon its sides spaces representing corresponding lengths of the chain, preferably in grams. Suppose, for instance, that the chain weighs five grams and that it is 10 inches long, then 10 inches of the rod should be divided into five parts, of two inches each. Thus it will be seen that each space will represent in weight of the chain, one gram, and subdivisions in spaces will represent corresponding subdivisions of weight in the chain.

All that is now necessary to determine roughly small weights is to lower into the scale pan of the balance as many links as may be necessary to counterpoise the article being weighed; and the weight of these links may be read off on the scale on the sliding brass rod, spaces and fractions of spaces corresponding to grams and fractions of grams.

On first sight it would seem that since the chain hangs, it can have no effect on the scale pan; such, however, is not the case, for those links which rest on the pan are unsupported by the rest of the chain.

CORRESPONDENCE.

OUR BOSTON LETTER.

The American Circular Loom Company, of 620 Atlantic avenue, Boston, have just gotten out a new catalogue and price list of their well-known "Canvass Jacket" wires and cables. In addition to a full description of their flexible wires and cables, the catalogue contains a number of valuable tables showing numbers, diameter, weight, length and resistance of pure copper wire, and also tests as to tensile strength, as made by the Ordinance Department, U. S. A., at the Arsenal, at Watertown, Mass. Taken as a whole, the little book contains much valuable information, and users of wire should send for one without delay.

The Proposed Change in the location of the Lynn and Boston Railway Company's tracks, which has been occupying the attention of the local authorities for some time past, is also creating considerable excitement among all classes of the citizens as well, whose convenience will be materially interfered with should the change go into effect. The officers and employés of the Thomson-Houston Company have now taken the matter up, and a petition to the Mayor and Board of Aldermen, protesting against a change of location, is being very largely signed by the men employed at the works. In one department no less than 205 signatures were secured one day last week, which signifies pretty plainly the sentiment of the men. The officers are also interested and a majority of them, from President C. A. Coffin down, have already signed.

The Subject of establishing a joint municipal electric light plant for the towns of Wakefield, Stoneham and Reading is now under discussion by the boards of trade and citizens of the respective towns, and it is probable that some plan, looking to the establishment of such a plant, will be decided on in the near future. Many ways and means have been suggested, and the general sentiment is strongly in favor of it. Immediate action has been postponed, pending the result of the negotiations for the purchase of the plant of the Wakefield Gas Company by the town, and if this is done it will be utilized as the main power station, and arrangements made to supply the other towns therefrom. As gas is now costing the consumers $2.50 per 1,000, there will be no unnecessary delay in bringing matters to a head.

The Woodward Underground Electric Light and Cable Company, of Lynn, Mass., have petitioned the city government for permission to give their system a practical test, and demonstrate the advantages they claim for it. They desire to lay a section of their tubing from one to three miles in length, and claim that telephone, electric light and other wires can be laid less than half an inch apart in their patent composition, and the present difficulties resulting from induction entirely overcome. This fact has already been demonstrated in connection with the system in Dedham, and a number of Lynn's solid business men are interested in the Woodward Company, and bonds have been offered for the faithful performance of the work. The Lynn *Item* very wisely suggests that the company be given a fair opportunity to demonstrate the advantages of their system, and the matter of street franchises left for future decision on their merits.

The Watertown Selectmen gave a hearing recently on the Newtonville and Watertown Street Railway Company's petition for a location on North Beacon street to the Boston line, and also for permission to run over the tracks of the West End street road to North Beacon Square. The company wants to use the trolley system. The road starts at Newtonville and has been built as far as the Watertown line under privileges previously secured. This new line means much for Watertown, as, if the ideas of its promoters are carried out, the line will furnish a direct and easy method of reaching Boston in a much shorter time than by present facilities. The route is over broad avenues. Horace B. Parker, president of the petitioning company, said it was purposed to build the line as quickly as possible, and as far as Prospect street, which bounds the Arsenal grounds. He thought the cars could be running this summer. The road was not to be a competing line with the West End, Mr. Parker stated, but would rather bring traffic to the cars of the latter. A connection would be made at the "Four Corners," Allston, which also would be the terminal point. After considerable discussion the petition was granted, the only change made being that iron poles be used through the center of the town. H. G. T.

Boston, June 24.

OUR CHICAGO LETTER.

The Trial Test of the electric buoys on Lake Michigan, although proving the success of the system, was not satisfactory, owing to lack of power. This will be remedied at once.

The Electric Fountains at Jackson Park were seen at their best Tuesday night, this week, by those remaining in face of a terrific storm, which continued throughout the night. It has been publicly announced on several occasions before that the fountains would be put in operation, and thousands would gather around them expecting to witness a grand sight, only to be disappointed through the failure of those in charge to make any display, owing to some trouble with the water pressure. This difficulty has finally been overcome, and hereafter the fountains can be seen in all their splendor every evening during the remainder of the Exposition.

Much Excitement was caused on the lagoon at the north end of Electricity Building, Saturday night last, by a collision between a gondola and an electric launch, which, but for timely assistance, would have resulted fatally. A gondola with eight passengers, including six ladies, was making for the north arch between Electricity and Manufactures buildings, when an electric launch, coming from an opposite direction under full motion, struck the gondola broadsides, completely overturning the boat, throwing its occupants into the water, where a great struggle for life took place. There happened to be several boats in the vicinity, which hurried quickly to the rescue and succeeded in getting the parties aboard, although this was not accomplished until after two of the ladies were about to sink for the third time. Since the accident Admiral Barney has issued strict orders regarding the running of the boats, and it is safe to say that accidents of this nature are not liable to occur in the future.

On Monday this week the Council of Administration took action that will doubtless add materially to the paid attendance at the Fair and at the same time prove a benefit and pleasure to thousands of city people as well as strangers who are at a loss to find comfortable out-of-door places to spend the summer evenings. The council has had for some time under consideration the question of opening the Exposition every evening, and having ascertained from practical tests that the public desires to be accommodated in this respect, has ordered that hereafter every evening the grounds will be open until 11 o'clock P. M. Since the opening of the Fair the attendance has been very large on days when the grounds were illuminated during the evening, and the management was not slow in recognizing the fact that it was the grand display and effects produced by electricity that drew the crowds, and have therefore decided to keep the Fair open every evening in the future. M. J. B.

Chicago, June 24.

PERSONAL.

Mr. P. Claus, of the P. Claus Dynamo Company, New York, sailed for Germany on the "Spree" last week.

Mr. E. D. Libbey, who presented a dress made of glass to the Infanta Eulalia, on the occasion of her visit to his magnificent exhibit at the World's Fair, has been notified that he has been appointed glass cutter to Her Royal Highness the Princess Donna Infanta Eulalia. The dress will cost about $2,500.

Mr. J. L. Ludwig, formerly of the Westinghouse Electric and Manufacturing Company, has opened an office in this city in the Havemeyer building, where he will represent the Altoona Manufacturing Company, the manufacturers of the Green engine, and the Railway Equipment Company, of Chicago, besides handling electric railway material of all kinds and doing a general contracting business. The ELECTRICAL REVIEW extends to Mr. Ludwig its best wishes for his success.

Mr. Samuel Carpenter, Eastern passenger agent of the great Pennsylvania railway system, has recently moved his offices to 1196 Broadway, in recognition of the general trend of the uptown movement of business in this city. The new offices are very conveniently arranged, and the company will, no doubt, increase its immense business out of this city as a result of the move. Mr. Carpenter is probably the most popular, as well as the most widely known, railroad man in the metropolis, and has managed the interest of the passenger department of his road on a broad-gauge basis that makes its patronage a constantly increasing one. The World's Fair travel is being provided for in a particularly satisfactory way by the Pennsylvania Company.

Some Advantages of Connecting the Coils of Electro-Magnets in Multiple Arc.

BY F. HIGGINS.

If two exactly similar electro-magnets of, say, 10 ohms resistance each and 1,000 turns of wire be employed, and one be connected in series in the usual way, and the other in multiple arc, the resistance of the latter will by so doing be reduced to 2.5 ohms.

With a current of 0.5 ampere in the circuit the second electro magnet will be magnetized by 250 ampere-turns, and the series coils by 500 ampere-turns; but the potential difference involved in producing the effect in the magnet connected in multiple arc is not a half, but only one-quarter of that required for the series magnet. Thus:

$\frac{5 \text{ volts}}{10 \text{ ohms}} = 0.5 \text{ ampere} \times 1{,}000 \text{ turns} = 500 \text{ ampere-turns};$

$\frac{1.25 \text{ volts}}{2.5 \text{ ohms}} = 0.5 \text{ ampere divided between two coils of 500 turns each, or } 0.25 \times 1{,}000 = 250 \text{ ampere-turns.}$

That is, 2.5 watts in the first case;
0.625 " " second "

A further advantage where speed is a consideration is that the induced discharge on closing the circuit being of much lower intensity, is more readily overpowered by the battery, and the magnetization more promptly established. The discharge on opening circuit being also proportionately lower in potential, is more confined to the bobbin.

Thus, it will be seen that by this method of connecting electro-magnets, more effect for a given current can be obtained under certain conditions, or two magnets may be made to do the work of one, at half the total expenditure of current required by a single similar magnet, and with greater promptitude in both charging and discharging.—*Journal of the Institution of Electrical Engineers.*

Advantage of a Reverse Index in the Telephone Directory.

The Columbus *Dispatch* offers the following advice to telephone companies:

It has been suggested that the telephone company would confer a great favor upon the community if, in the future patrons' lists, there should be published a reverse index. This is unquestionably a good idea. Everyone who has wandered through the numbers, great and small, in the vain hope of finding out whom a certain number may mean will appreciate the value of a plan which will make such information easy to acquire. For instance, Mr. John Smith leaves his office for a few minutes and upon his return finds a memorandum telling him to call up a certain number. Now, Mr. Smith may have very good reasons for not wishing to converse with one or two and, perhaps, more people, and so he hesitates and regards the number dubiously. Then he gets his telephone book and, beginning with the letter A (he would do better, usually, if he began with Z), runs his index finger down the line and turns page after page in his fruitless quest. Of course, he misses the number and so is obliged to take his chance. How much better would it be if one could turn to a portion of the book which contained the names of the subscribers arranged with regard to numerical consecutiveness.

We commend this proposed reform to the telephone company. It would entail little trouble and expense to include such a reverse index in the next book, and for the desirable improvement there would be the unbounded gratitude of a host of people.

All this may be avoided by Mr. John Smith's telling his office boy to be careful to obtain the name of the person at the other end of the wire.

A Mnemonic.

TO THE EDITOR OF ELECTRICAL REVIEW:

If good the road (R) and heavy the load (r) Connect your cells "abreast;" $C = \frac{E}{R + \frac{r}{n}}$

If bad the road (R) and light the load (r) Then "tandem" is the best. $C = \frac{nE}{R + nr}$

The above is a verse I give to my classes in physics for remembering how to join up cells in a battery. "Road," external circuit. "Load," internal circuit.

T. BERRY SMITH.

Fayette, Mo., June 10.

A newspaper man was robbed of a $500 diamond at the Sheepshead races. Newspaper men should not carry diamonds. We never do.

Electrical Happenings in Bungtown.

The editor of the *Bungtown Blizzard* has realized that electricity has made very rapid strides. In consequence he has put into his most valued journal an electrical column, a few extracts from which may prove interesting reading to the community at large, even if the happenings are merely of local importance:

Yesterday evening brother Eb. Weigwurst's pet mule "Mabel" tried to stop one of the trolley cars which was going full tilt down Turnip street. Mabel did not realize that "the juice" was more powerful than she, and she now may be twanging a golden harp with her front hoofs. Pretty Mabel will no longer rest her lovely face against the pane any more.

Last week Deacon Elderberry was much shocked to hear that Mark Crittenden the engineer ran off with his (the deacon's) wife. Mark will never more squeeze oil onto the dynamo. No, Mark, oil is not in your line now.

Brother Rufus Whitcomb does not believe in the motto: "The good die young." He rented a house on the corner of Myrtle and Peach streets, where the electric cars cross the railroad tracks, and he sends out his mother-in-law to ride on the cars every afternoon. She is improving, while Brother Rufus grows thinner. What strange things do exist!

Last year Uncle Silas Rockbottom bought some shares of the rival electric light company's stock. He is now cutting coupons off the wrong end and using the paper for memoranda. He says that the paper is most excellent. Notice! Uncle Silas will trade those shares which he has left for Confederate bonds.

Our good friend Mr. Peters (see advertisement on front page) has moved his telephone to the rear of his grocery store. Last week the telephone wouldn't work, but brother Peters remedied this by signing his name to a check in payment of last month's telephone rental. Ha, ha, Pete, that is one on you.

Young Bill Perkins doesn't like our new arc lights. We don't know whether the fact that Bill tried to light a cigar at one of 'em has anything to do with his prejudice or not. How 'bout that, Billy?

Fie, for shame, Brother Jimmison, we thought you were more intelligent. We overheard you trying to explain to your little Willie how the trolley works, and, gracious, what a woful mess you did make of it! For the benefit of William we would say that papa's explanation was a trifle rocky. This is how she works: The fluid comes from the power house where it is made, and goes through the long copper tube and then into the car. While it is in the car it spreads along the bottom and sets the wheels agoing. This produces friction which, controlling the motion of the truck, maintains a decided leverage upon the cam, which, in turn, controls the commutator. Motion is now transmitted from the bushings to the generator, and from thence to the involute gearing. As soon as the mechanical equivalent of the heat thus produced is enough to satisfy the motorneer that the pole pieces are in close enough proximity to the rheostat, he throws the switch which is attached to the amperemeter and the wheels revolve. This, Willie, is the way "the wheels go wound." Although we were perfectly sure of our knowledge, "to make assurance doubly sure" we asked the man at the power station and he told us. Now, Jimmie, old fellow, aint you ashamed of yourself? Brush up a little on electricity.

Resistance Metal Inquiry.

We have had several inquiries for the address of the manufacturers of the resistance metal, mentioned in the last paragraph on page 208 of the ELECTRICAL REVIEW for June 10, 1893. Will they please answer to this office?

Preliminary Programme of the International Electrical Congress.

TO BE HELD IN CONNECTION WITH THE WORLD'S COLUMBIAN EXPOSITION, CHICAGO, U. S. A., BEGINNING AUGUST 21, 1893.

Opening Session of the General Congress, Monday, August 21, 3 o'clock P. M.*

ORDER OF BUSINESS.

1. The Congress will be called to order by the chairman of the advisory council, Dr. Elisha Gray, Highland Park, Ill.

2. Election of temporary chairman and secretary.

3. Appointment of a committee to nominate permanent officers. The officers will consist of a president, a vice-president for each nation sending delegates to the chamber, and a secretary.

4. Report of this committee.

5. Short addresses by the president and by a few of the vice-presidents.

6. Announcements and adjournment.

At the close of this meeting the Chamber of Delegates will assemble for preliminary organization, which will proceed as follows:

1. The Chamber will be called to order by one of the delegates representing the United States.

2. Election of a temporary secretary.

3. Appointment of a committee of five on credentials.

4. Fixing a time for regular session. Adjournment.

At the next meeting of the Chamber the committee on credentials will report, and a permanent organization will be completed.

DIVISION INTO SECTIONS.

The General Congress will be divided into three sections, as follows:

A—The section of Pure Theory, including electric waves, theories of electrolysis, electric conduction, magnetism, etc.

B—The section of Theory and Practice, including studies of dynamos, motors, storage batteries, measuring instruments, materials for standards, etc.

C—The section of Pure Practice, including telegraphy and telephony, electric signaling, electric traction, transmission of power, systems of illumination, etc.

These sections will meet for organization and work at 10 A. M., August 22.

Their organization will consist of the election of a chairman, a vice-chairman, a secretary and a sectional committee of three in addition to the officers named above. Temporary presiding officers will be as follows:

Section A....Prof. H. A. Rowland.
" B....Prof. Charles R. Cross.
" C....Prof. A. Graham Bell.

Sections will meet at 10 o'clock A. M., on Tuesday, Wednesday, Thursday and Friday, continuing in session at will, except on Friday, when they will finally adjourn as sections not later than one o'clock, P. M.

Each section will have authority to divide into sub-sections if it is thought to be desirable.

Papers are solicited upon the following subjects, or upon other topics which may be considered suitable in character.

They should be sent to the chairman of the programme committee not later than August 1, 1893. Such as are accepted by that committee will be put upon the programme of the Congress, to be presented in full or by abstract, according to the time available.

Magnetic units and modes of embodying them in concrete standards.

Methods of avoiding electrical interference and risks to person and property.

National and municipal testing laboratories.

Materials for standards of electric resistance.

Points of difference of the electrical vocabulary used in different countries.

The direct conversion of the energy of fuel into electric energy.

Comparison of the various methods employed for the electric transmission of power.

The cost of insulation in relation to high pressure for the electric transmission of power.

Comparison of the economies of the various systems of electric distribution.

Alternate current motors.

The behavior of transformers when supplying power to alternate current motors.

The construction of condensers for alternate current purposes.

The measurement of power in polyphase currents.

Direct coupled and non-direct coupled dynamos.

The use of equalizing dynamos in a three and a five wire system.

The use of accumulators in central stations.

The proportions between output of dynamos and the weight of copper and iron employed in their construction.

Electric traction.

Application of electric power in mining.

The adoption of a uniform method of distinguishing positive and negative mains.

Electric supply meters, American, British, Continental.

Criterion of sensibility of galvanometers.

Commercial instruments for measurement of electric quantities.

The relation between the voltage of the arc and the quality and composition of the carbons.

The aging of glow lamps.

The electric working of metals.

The use of electric and magnetic tests for ascertaining the mechanical properties of metals and alloys.

The best material and mode of erection of lightning conductors in the light of recent researches in electric discharges.

The prospecting for iron by magnetic surveys.

International telegraphy.

Fast speed and long distance telegraphy.

The use of batteries or other generators for telegraphy.

Telegraphic lines—land and sea.

Harmonic telegraphy.

Writing telegraphs.

Long distance telephony.

The possibility of providing telephonic communication without wires.

Application of electric signaling to the working of railways (alarms, time, etc.), and to naval and military purposes.

Magnetic separators.

The use of electricity in engraving and in art reproductions.

The time allotted to the discussion of the papers presented will be determined by the several sectional committees. In the discussion of papers the chairman of the section will name the first speaker.

THE CHAMBER OF DELEGATES.

The following topics will be considered by the Chamber of Delegates:

Adoption of definitions and values of fundamental units of resistance, current and electromotive force.

Adoption of definitions and values of magnetic units.

Adoption of definitions and value of the unit of self-induction.

Definitions and values of light, energy and other units.

The standardization of electric lights.

The consideration of an international system of notation and conventional symbols, and of a more uniform and accurate use of terms and phrases in electrical literature.

A commercial standard of copper resistance, together with such other topics as may properly come before this body.

The hours of meeting for the Chamber of Delegates shall be determined, after the first session, by the Chamber itself; and it shall also decide upon the admission of persons not delegates to its sittings.

It shall finally adjourn not later than 1 o'clock P. M., on Friday, August 25, and at the last meeting of the General Congress the officers of the Chamber shall report to it a summary of its proceedings and the conclusions reached.

Public lectures of a popular character will be delivered by eminent electricians at 8 o'clock P. M., on Tuesday, Thursday and Friday of the congress week.

The General Congress will assemble to hear reports and for final adjournment at 3 o'clock P. M., Friday, August 25.

Prof. T. C. MENDENHALL, Washington, D. C., *Chairman.*
CARL HERING, Philadelphia, Pa.
Prof. W. A. ANTHONY, Manchester, Conn.
Prof. H. A. ROWLAND, Baltimore, Md.
A. E. KENNELLY, Orange, N. J.
Prof. F. B. CROCKER, New York city.
Prof. E. L. NICHOLS, Ithaca, N. Y.
Prof. H. S. CARHART, Ann Arbor, Mich.
Committee on Programme.

* NOTE.—The "General Congress" will include a smaller body, to be known as the "Chamber of Delegates," which will consist of those specially designated as representative delegates from the various governments, appointed for the purpose of considering electric units and their values, and making recommendations as to the legalization of the same.

The Tendency in Central Station Design.

It is instructive to periodically survey what has been done in any branch of engineering industry and to submit the results to critical examination. It has well been said that we often learn as much from failure as from success. The effect which so often follows in the wake of success, the natural feeling that something having been accomplished it is meritorious to lie on one's oars for a time and to point with gratification to the realization of long cherished hopes, does not tend to continued progress. But in engineering we have little cause for such self-adulation. The gigantic successes are unfortunately often paralleled by not less magnificent failures. True, the net result of the world's work is a movement onward, and let us hope upward, and we are to-day a step in advance of what we were yesterday, but at what a cost is each advantage gained. It has often been said that if there were two ways of doing a thing, mankind in the abstract delighted in attempting the wrong one. In constructional work, generally, the old method of trial and error has certainly been productive of results upon which the present-day engineers can pride themselves, but it is somewhat startling that, despite all the money and brain power expended upon technical education, we should be largely dependent upon the same method for obtaining some degree of uniformity in our engineering designs. Beyond the capital which is uselessly sunk in unproductive ventures and the consequent distrust of the capitalist in investments which are so precarious in their tenure, it is not to be regretted that progress is, as a rule, most certain where it is not marked by extreme rapidity. These remarks apply generally to those branches of engineering industry which are of modern growth, but which have an especial bearing upon central station construction. The design of an electricity generating station is a requirement of quite recent times; some years ago engineers did not include such work in the course of their professional routine. Two reasons can be adduced for this. First, there were no central stations, as we know them, to design; second, those which were in existence were not engineering works, but the creations of physicists, who liked to fancy themselves engineers, and of sanguine inventors whose claims to recognition were principally a ready tongue and a plausible address. More is the pity that these were often denied to men with more evenly balanced minds, who put forward schemes much less chimerical in conception, and who possessed, had it been but recognized, vastly superior capabilities of carrying out their ideas. But it is from these that the business man often turns away. He is prone to regard modesty as incapability, and reserve as ignorance. No doubt other causes were at work to retard the construction of works similar to those which are at the present moment being carried out with so much activity, but those which we have indicated certainly exercised an influence which has been much underrated. The design of central stations has been influenced largely by the capital at the command of the designer. In the early days of electric lighting, the tenure under which companies held concessions or powers was so precarious that pecuniary support was most difficult to obtain. This hampered those who had an idea of what was required to successfully carry out the schemes which were authorized, and it must be owned that the majority of engineers in those days did not possess definite views even if the resources at their command had been vastly in excess of what was actually the case. Circumstances compelled them to carry out the necessary works in a more or less temporary manner, and we well remember the curious combinations of plant of all sorts and sizes which were dignified by the title of "central stations" early in the eighties.

Indeed it seemed very much as if engineers who had to do with the early electrical concerns had lost their mechanical skill and forgot the lessons taught by bitter experience, for the "engineering of electrical engineers" became a reproach and a by-word. The term was used to express everything which was unmechanical and makeshift. The inevitable result followed, and the distrust which repeated failures and non-fulfillment of promises engendered in the public mind has yet to be wholly uprooted, although since the advent of the present decade much has been done to reassure those who permit themselves to deal impartially and justly with this later development of industrial science.

Much credit is given to the Act of 1888 as a means of enticing capital back into electrical investments, and no doubt that piece of legislation did something in this way, but it can hardly be doubted that its influence has been given undue prominence. Commercial prosperity, coupled with increasing industrial activity at home, has freed a large amount of capital, which drifted into the hands of electrical promoters, who, on the whole, made good use of their opportunities, and have produced, by gradual improvements, the modern central station. Those engineers who took up electrical work some eight or nine years ago found their new branch a lucrative one, and have had no reason to regret their choice. It is to them we owe much of the good work which has been done. The cry was for "systems." Inventor after inventor brought out a combination of dynamos, regulators and switch gear, to which he gave his name; but of all the host not more than one or two have survived the test of time and practical examination. The plants which are now at work bear no resemblance to the old systems; indeed, they are all of comparatively recent design, and where they have been developed from the ideas of one of the older class of inventors they have been from time to time so modified in detail that to-day they have little in common with their prototypes. Nine-tenths of the machinery employed in generating electricity is purely mechanical. The boilers, engines, steampipes, forced-draught apparatus, coal and ash conveyors, travelers, and rope gearing, if direct driving is not resorted to, are neither more nor less than ordinary mechanical and steam engineering appliances, although they perform their duty under special conditions and require to be designed for the class of work they have to perform. Regularity of running, a uniform angular velocity, and a small average steam consumption are of vital importance, while first cost can be discounted if the result is to enable depreciation to be taken at a low percentage upon capital value of the plant. In the latter respect a healthy state of opinion is gradually making itself felt; the fallacy of sacrificing everything to an apparent saving in first cost, is becoming recognized by the business man who has usually to adjudicate upon competing tenders. Be he vestryman, town councillor or director, he will find that whatever his preconceived notions may be, a little experience and perhaps one or two mistakes in this respect will pave the way for a better understanding as to where true economy comes in. Solidity and thoroughness are the features which distinguish the works of to-day from those of a few years ago, and the engineer who finds his lot cast where such principles are the guides of action, may well devote his attention to perfecting the details, for the main structure will bear any improvements and modifications it may be in his power to make. Already something like one-tenth of the private lighting of the metropolis is dependent for its continuance upon a supply of electricity, and it is only by fulfilling the moral obligations under which it rests that electric lighting will increase and prosper.—*London Industries.*

Eastern Electric Cable Company.

The Eastern Electric Cable Company, of Boston, has declared its regular semi-annual dividend of three per cent. on preferred stock, payable June 27. Books open June 28.

ELECTRIC RAILWAY AND POWER NOTES.

The Detroit Electrical Works' plant was sold last week on a foreclosure suit for $100,000.

The Marlboro, Mass., Electric Street Railway tracks have been laid to South Marlboro.

A new electric road is under consideration to connect Amsterdam, Johnstown and Gloversville, N. Y.

The Keystone Electric Works will move to their new works in the old fair grounds in Erie, Pa., on July 1.

It is announced that the electric railroad at Burlington, N. Y., will be in operation by the middle of August.

The new electric power house at Superior, Wis., will cost $100,000, of which sum $95,000 will be for machinery.

A scheme is on foot to furnish Los Angeles, Cal., with electricity generated by water power from the San Gabriel river.

The South Chester, Pa., borough council is making an effort to put a tax of $1 per pole on the trolley poles of the Union Street Railway.

A monster electric traveling crane has been added to the equipment of the converting mill of the Edgar Thomson Steel Works, at Pittsburgh, Pa.

A trial trip was taken last week on the Pottstown, Pa., trolley line. Everything worked satisfactorily. The line will be open for business in a few days.

The Westchester Electric Company has secured control of the electric railroad system franchises through Eastchester, New Rochelle and Pelham, N. Y.

The work of putting in the new 200 horse-power engine at the Troy, O., Electric Light Works is about complete. The power will be used to run the street railroad.

Tonawanda, N. Y., may have another electric road. Some of the people owning property there have almost decided to build a road through their land in order to open it for the market.

Work on the Lowell, Lawrence and Haverhill, Mass., electric road was begun recently at both ends of the route, at Lawrence and at Haverhill. It is expected the road will open from Haverhill to Lawrence by September 1.

The Westchester Electric Company has obtained permission from the New York State Board of Railroad Commissioners to use the electric trolley power on the recently acquired roads in South Mount Vernon, New Rochelle and Pelham.

A survey of the route for an extension of the Midland Electric Railway in St. Louis County from the present terminus, corner of Page avenue and Hanley to Creve Cœur Lake, has been completed. The extension will be about 10 miles in length.

The Stanley Electric Manufacturing Company, of Pittsfield, Mass., is now at work upon a 300 horse-power generator to be used by the Stanley Laboratory Company at their quarters on Allen avenue. It is the first generator the company has attempted to make.

In addition to the building of an electric railroad from Frederick to Middletown, Md., another project is now being agitated in that section looking to the construction of a similar road from Gettysburg, by the way of Emmittsburg, Mechanicstown and Frederick, to Washington.

The State Central Electric Railway Company have accepted the franchises granted to them in Westboro, Northboro, Shrewsbury and Grafton, Mass., but matters yet hang fire in Worcester, where the city government imposes conditions practically debarring the company from entering the city in the way proposed.

A deal has been concluded whereby the Newark Passenger Railway Company, which operates the trolley line from Newark to Orange, formally passed into the hands of the Consolidated Traction Company, controlled by Messrs. Crimmins, Widener and Elkins. The Newark stock is taken at 35 in exchange for consolidated 5 per cent. bonds at par. It is planned to make a through electric line from Jersey City to the Orange Mountains, and another from Elizabeth to Paterson.

The Pittsburgh, Allegheny and Manchester Traction Company, the Federal Street and Pleasant Valley Passenger Railway Company and Allegheny Traction Company, of Pittsburgh, Pa., have at last been consolidated. A meeting of the representatives of the different companies was held in Pittsburgh last week, at which articles of agreement were signed, but are subject to the ratification of the board of directors of each company. The capital stock of the new corporation is put at $5,000,000, of which the Pittsburgh, Allegheny and Manchester Company furnishes $3,000,000, the Pleasant Valley $1,400,000, and the Allegheny Traction Company $600,000.

E. J. Pennington, representing the Chicago and Central Indiana Electric Railway Company, with headquarters at Noblesville, Ind., makes definitely known the plans of the company, which are on a large scale. The line between Indianapolis and Noblesville will be a double track, and the double track will be extended to Chicago, *via* Sheridan, Frankfort and Lafayette. A single track will be laid to Kokomo, *via* Tipton, and at Kokomo there will be extensions to Logansport and Peru. Another branch from Noblesville will lead to Fort Wayne, *via* Elwood and Marion, while a fourth will go to Muncie, *via* Anderson.

The "Aluminum-Iodine" Portable Testing Battery.

The testing battery illustrated herewith is a new form that has been thoroughly developed in the experimental department of Queen & Company, Incorporated, Philadelphia, and is now placed on the market by this company with expectation of a large demand. In chemical composition the "Aluminum-Iodine" cell is quite different from anything heretofore known, and possesses important features, the most essential of which is electromotive force. Each one develops a voltage of $1\frac{4}{10}$ volts, which is fully 50 per cent. more than the output of an ordinary "Chloride of Silver" cell. The effect, as will be seen, is that 50 aluminum silver cells have the same efficiency as 75 of the other type, so that great economy in first cost results.

QUEEN & COMPANY'S "ALUMINUM-IODINE" PORTABLE TESTING BATTERY.

The cells are prepared with great care, and those used in the laboratory of Queen & Company for months past have shown remarkable constancy and long life. There is no danger of explosion or leakage, and local action is practically eliminated, so that when not in use there is no injurious waste. The cells are mounted in handsome polished mahogany cases in sets of 50, more or less, as desired. A battery of 50 cells gives 70 volts electromotive force, which is quite sufficient for all ordinary work. Electrical engineers in testing the insulation of submarine or underground cables often require 200 or 300 volts to secure proper sensibility in results, and a battery of as many cells can readily be prepared if desired.

The "Acme" portable testing set, also manufactured by Queen & Company, contains 12 "Aluminum-Iodine" cells, which they propose to use entirely in place of the regular "Chloride of Silver" form. The makers are prepared to meet a large demand for this new specialty, and interested parties should write them for a copy of descriptive circular No. 445.

ELECTRICAL ILLUMINATION OF THE RUSSIAN MAN-OF-WAR "DMITRI DONSKOI."

A Big Electric Deal in New Jersey.

THE CONSOLIDATED TRACTION COMPANY NOW CONTROLS ALL IMPORTANT PLANTS IN THE STATE.

Three deeds were filed in the Essex county Register's office in Newark, N. J., on June 21, just before the hour of closing, and they practically end the gigantic deal whereby the Consolidated Traction Company, with a $40,000,000 capital, and the rival electric light and power companies of Newark and adjacent cities were merged into one big monopoly, with an unknown capital and complete and absolute control of the street car and lighting privileges of every city and town of any size in the State of New Jersey.

The first deed was for the transfer of the plant and franchises of the Schuyler Electric Light and Power Company to the United Electric Traction Company for the consideration of $1. The second conveyed the same from the United Electric Traction Company to James M. Smith for the consideration of $400.

The third conveyed the same, together with land and tenements, from James M. Smith to the Central Power Company for $117,000. That closed the deal until June 21, when the Central Power Company reorganized with a capital of $200,000, and merged into the big combine.

This practically explains why R. J. Lemassena, A. Q. Keasby, Henry Congar, Dr. J. H. H. Brientnal, W. H. Bennett, James M. Smith, A. B. Coelin, and others, all of whom are interested in the Central Power Company, disposed of their Newark Passenger Railway stock to the big syndicate at an apparent sacrifice a few days ago.

The Schuyler Company, which is now absorbed, was the only snag in the path as the big consolidation. It was organized of an opposition company and created trouble until last January, when it went into the hands of a receiver and was eventually sold to James M. Smith and others, representing the United Electrical Traction Company, a corporation formed with a $700,000 capital several years ago to operate electrical plants in New York, New Jersey, and Pennsylvania. While it never operated any, it controlled many, all of which by the deal of yesterday were merged into the big combine.

Electric Illumination of Russian Men-of-War.

The decorative illumination of war vessels by means of small incandescent lamps was a new wrinkle introduced with great effect during the recent Columbian celebrations in New York, and the beautiful scene when the vessels were outlined in light against the black background of the night was not the least attractive part of the famous naval display.

The occasion of the birthday of the Czarowitch gave the Russian Admiral a chance to distinguish himself, and offer to the expectant public a view of his vessels at once beautiful and effective. The cut gives some idea of the illumination of the "Dmitri Donskoi." The vessel was outlined in lamps from truck to water line, while between the masts was suspended a brilliant reproduction of the initial letter of the reigning Romanoff's name, surmounted by the Russian Imperial crown formed of scintillating lamps of different colors. In the position on the bowsprit usually occupied by the "Jack" gleamed a small bright star.

The "Rynda's" decorations consisted of the crossed Russian naval and American flags surmounted by a five point star.

The work was done by the lamp department of the General Electric Company, under the immediate supervision of Messrs. G. C. Baillard and C. A. Gundaker, while Lieut. André de Pekrowsky of the "Dmitri Donskoi," himself a skilled electrician, lent valuable aid in effecting the installation.

To the Point.

Ten girls in a composition class in a Cincinnati school were told by their teacher to write a telegram such as would be suitable to send home in case of a railway accident while traveling. One of the girls wrote: "Dear Papa: Mamma is killed. I am in the refreshment room."—*New York Tribune.*

ELECTRO-CHEMICAL EFFECTS DUE TO MAGNETIZATION.

(*Continued from page 241.*)

strongly magnetized to the neutral parts of the iron. This concentration effect increases rapidly with the amount of iron salts present and the fluidity of the solution.

The convection currents in the liquid are themselves a consequence of this same concentration, being electro-magnetic rotations produced by the action of the magnet upon the local electric currents between different parts of the iron.

As to the permanent current, due to the magnet which is finally set up between the electrodes, as shown in Fig 1 (II), it is probably due to a change in the character of the reaction produced by the concentration of the iron salts about the more strongly magnetized parts, which would tend to cause a ferrous instead of a ferric reaction to take place, and thus increase the electromotive force.

NOTE.—Since the completion of the above investigation, a number of experiments have been performed similar to those of Professor Remsen. Starting with the known existence and direction of the electric currents in the liquid, it was thought that these might lead to some explanation of the peculiar form of deposit in equipotential lines. A number of interesting facts have been noted, but they are withheld for further experiment.

G. O. S.

Western Union Figures.

The estimated return for the quarter ending June 30 is:

	1893.	1892.	1891.	1890.
Net revenue.	$1,750,000	$1,750,000	$1,500,000	$1,750,000
Int. and S. F.	243,335	242,938	242,898	243,143
Balance..	$1,506,665	$1,507,062	$1,257,102	$1,506,857
Dividend....	1,185,250	1,077,411	1,077,400	1,077,395
Surplus...	$321,415	$429,651	$179,702	$429,462
Total surpls	6,920,313	13,515,556	11,328,078	10,020,377

Statement for the year ended June 30, this year partly estimated:

	1893.	1892.	Changes.
Net earnings.....	$7,568,129	$7,398,547	Inc. $169,582
Int. & sinking fund	933,331	930,523	Inc. 2,808
Net profits.....	$6,634,798	$6,468,024	Inc. $166,774
Dividends.....	4,652,102	4,309,638	Inc. 342,464
Surplus.....	$2,002,696	$2,158,386	Dec. $155,690

The statement shows the earnings on the stock for the year to have been 6.63 per cent. compared with earnings of 6.46 per cent. on the same amount of stock for the year preceding. Of the $6,920,313 surplus, as of June 30, 1893, $5,180,000 are represented by 51,800 shares of Western Union stock held in the treasury of the company. The surplus for the year, $2,002,696, has been applied to the purchase and enlargement of the Phenix Building at Chicago (about $1,700,000), and to the construction of new lines. The actual revenue for the March quarter was $1,584,434, against estimated revenue of $1,675,000.

Telegraphers' Tournament at St. Louis.

A telegraphers' fast sending and receiving tournament was held in the exposition building at St. Louis on June 18, before a large crowd of telegraphers and their friends. The matter was selected from the morning newspapers, and each contestant had five minutes. The results were as follows:

Class A—Old Timers, sending—B. B. Grandy, first, 191⅞ words; M. D. Crain, second, 187 words; Charles Palmer, third, 172¼ words.

Class B—Ladies, sending—Miss Hattie Florke, first, 191 words; Mamie McLaughlin, second, 187⅜ words; Pauline D. Bauer, third, 180¼ words.

Class C—Men under 25, sending—L. C. Bader, first, 193⅜ words; J. A. Jakle, second, 192½ words; Thomas Bastable, third, 188¼ words.

Class D—Free for all; perfection of work to be considered. C. H. Shell, first, 189¼ words; Jas. McIlvain, second, 195½ words; T. M. Eckert, third, 191⅜ words.

Class E—Receiving with pen; James Armstrong first, William Ernsthauser second, H. J. Horn third.

Class F—Receiving on typewriter; E. S. Bowers first, Thomas Bastable second, J. R. MacGill third.

Bement, Ill., is soon to have an electric light plant.

Electricity as a Fire Hazard.

BY C. J. H. WOODBURY, M. A., VICE-PRESIDENT, BOSTON MANUFACTURERS' MUTUAL FIRE INSURANCE COMPANY.

[Read before the Fire Insurance Congress, at the World's Columbian Exposition, Chicago, Ill., June 22, 1893.]

Electricity in the form of lightning undoubtedly constituted the first fire hazard, which has continued to this day, but it is proposed to limit this paper to a consideration of the fire hazards from electricity in the service of mankind.

The introduction of electricity for illumination has contributed a new hazard to the dangers of civilization, and also imposed upon underwriters new methods, which in turn may establish as radical changes in the practice of insurance as the electric light and the motor have in the economic and mechanical world.

Underwriting, pure and simple, assumes the risk and charges accordingly, to the amount best estimated by a judicial consideration of the hazard as predicated by experience. In course of time efforts have been made to modify the risk by eliminating elements of greater hazard from parts of a risk, such as the removal of picking or drying from the main building of a textile mill, by adding to the fire apparatus, or by encouraging certain changes in construction.

With electric lighting apparatus it was found, at an early day, that the hazard was largely dependent upon methods of installation, and not, therefore, absolutely an inherent danger inseparable from its use. In order, therefore, to determine these conditions it was necessary to provide inspections, made by those familiar with electricity, but not necessarily acquainted with other matters of fire hazard and its defense already known to underwriters. This introduced the thin of the wedge forcing the technical man into insurance practice.

It was not that the necessity of a knowledge of the wide range of conditions comprising the fire hazard was not fully appreciated, but that such experience had not been applied in connection with the practice of underwriting on a sliding scale.

The applications of electricity previous to its use for lighting and power were not considered to form a hazard. On the contrary, its use in connection with the municipal fire alarms has been of the highest value, and, indeed, essential to that prompt service of the fire department which is the salvation of American citizens, built with careful reference to every feature entering into their conditions save the fire hazard.

None of the apparatus for the transmission of signals was a cause of fire, and the wires were not sufficiently numerous to be considered obstructive until the introduction of the telephone increased their numbers to such an extent that they almost shaded the sun, like the arrows of the Persian army.

When these telephone or telegraph wires come in contact with electric lighting wires, heavy currents are conducted by them and imposed upon apparatus which is of insufficient conductivity, and the electricity is converted into heat sufficient to cause fire. In this matter the march of invention has proved equal to the necessities of the case, and although the result has been reached by dearly bought lessons, the problem has been solved by the telephone interests in devices for the protection of their instruments against the various classes of foreign currents liable to be imposed upon them.

The protective apparatus is fourfold in its nature. Lightning is averted by lightning arresters; incandescent lighting currents, by fusible wires in glass tubes, or by tinfoil wrapped with asbestos paper; arc lighting or power currents of great pressure are turned in other directions by air cut-outs; and finally intermittent currents through high resistance and of volume too great for the apparatus, known as "sneak" currents, are shunted by a ball of bayberry wax pressed against the coils of an electro-magnet in the apparatus by a spring switch, and when the magnet becomes warm by abnormal currents, the ball softens and causes the currents to be switched out of circuit.

Electric wires serve as a defense against lightning by presenting such an inductive action upon the electrical condition in the clouds as to reduce the difference between the earth and the clouds, and therefore to diminish the violence of the electrical discharges constituting lightning. It is this defense by the wires which has reduced the losses by lightning strokes in cities during recent years.

Most of the so-called strokes of lightning on telephone and telegraph instruments are not the direct lightning strokes, but are inductive currents of far less potency, which by their greater number diminish the violence of the direct stroke which follows.

The overhead wires are, however, a serious hindrance to the operations of the fire department, and will continue to be so until a fully practicable system of underground wires performs the same service, for one system will not be substituted for the other save under this condition.

The telephone companies are placing the wires underground to the greatest extent possible under existing conditions; but the overhead wires for the street railways appear to be a necessity until the public service for the transportation of large numbers of people in cities, with the same rapidity and promptness, and with assured operation in all weathers and under all conditions, can be performed by some other application of electricity in a satisfactory manner.

Underground wires are not of necessity safer than those overhead, for the contact with the earth increases the danger wherever the insulation becomes insufficient from any cause, and there is no leak so persistent and elusive as an electrical leakage.

The principal dangers from underground wires are: First, diverting the electricity by earth connections through conductors of combustible material and high resistance, such as buildings, thus causing fires. Second, the currents of electricity dissociating water by electrolysis into its two gases, and then igniting this explosive mixture by an arc. Third, the earth return currents used in trolley street railway service have impaired water mains by electrolytic action; and, indeed, such currents have destroyed the insulation on other underground wires, whose insulating covering was surrounded with metallic tubing.

In the uses of electricity there is a wide distinction to be made as to whether the electricity is generated on the premises, or whether it comes a long distance from a central station. In the former case the apparatus is designed for the service to be required from it, and the wires are not exposed to lightning. In the latter case there is the exposure to lightning and the liability to excessive electrical conditions, both as to current and pressure.

Experience is showing that for a system of illumination electricity can be made fully as safe as any other method. The improvements in the methods of installation of such apparatus can be ascribed to the improved insulating materials and fixtures, as well as to more efficient means for regulating the electrical apparatus, rather than to any new realization of the results desired many years ago.

It is assumed that this is not the place for the details of underwriters' rules, which have proven so efficient in establishing conditions of safety in the transmission of electricity for lighting and power. In a few words, the essentials of safety can be said to include the necessity of preventing arc lights from scattering sparks, confining the electricity to its metallic circuits, furnishing conductors of ample capacity, protecting the apparatus by properly arranged safety fuses, and arranging the switches so that they shall not cause dangerous arcs.

The depreciation of much of the apparatus in use must in time become a serious question, especially with the earlier installations, where both methods and material are far below the present standards.

Electricity is in the position of an essential adjunct to the world's work in manufacturing and in illumination; and the use of these wires, conveying vast amounts of energy which can be converted from its legitimate service in illumination or power into a torch of destruction, is increasing with such rapidity that it is in this field that the work of the underwriter must keep pace with the advance of constructive invention by the exercise of equally defensive methods.

Wall Street and the Electrical Stock Market.

The financial situation of the country is showing signs of some improvement. The liquidation in the middle West seems to have about run its course, the railroads are reporting a good business and trade reports show that collections are slightly better. The Wall Street market has been extremely irregular, narrow and to a marked degree professional. It has hinged upon the relations of money to exchange. On Tuesday money was run up to 25 per cent. This caused a large influx of banker's exchange bills, which were offered as loans. Exchange immediately became easier, and on Wednesday dropped as low as 4.82¾ to 4.83 for demand and 4.80¼ for 60 day bills. This caused an easing in money on Thursday, which put up exchange to 4.86. High exchange caused an advance in money rate on Friday to 20 per cent., which in turn caused a drop in exchange to 4.84. It is seldom in the history of Wall Street that such violent fluctuations have taken place in the exchange market, and indicates that the condition of affairs is decidedly unsettled. Broadly speaking, it can be said that money has been tight all the week. Shipments to the interior during the early part of the week, and to the Pacific coast on Thursday and Friday in relief of the financial distress in that section, were largely responsible for the high money rates here. The bearing on the market has been a most depressing one. Brokers are forced to carry stocks for their customers at six per cent. When they have to pay as high as 20 per cent. for money, it can readily be seen that they discourage transactions. As a result, the bears have been left in control of the situation. They have utilized their opportunity to its greatest extent, and in consequence the market has sagged during the greater part of the week, rallying only on the spasmodic easing of money. The key to the market during the coming week will be the money rate. If it works lower in consequence of offerings of bankers and commercial bills, as well as an inflow of currency from the interior, which is predicted within the next few days, there will be a comparatively heavy buying movement, resulting in the advance of prices, that would be augmented by a partial covering of the short interest, which is now very large. The commercial world is still suffering from the financial depression, this fact being indicated by a continual feeding out of investment securities by brokers who have commercial connections.

The only stocks in the electrical list which were at all active were General Electric and Western Union. The former shows a little buoyancy whenever bear pressure was withdrawn from it for the moment, while the latter sagged through a greater part of the week. The net change in quotations as compared with the closing on Saturday was slight up to this morning. General Electric broke this morning to 69⅞ upon bear hammering.

The threatened opposition to the North American management did not develop at the annual meeting of last Wednesday. The report of the company refers chiefly to the results of operation of the Milwaukee Street Railway Company and the Cincinnati Edison Electric Company.

The Milwaukee Street Railway Company has been in a transition period on account of the work of converting the line from animal traction to electric motive power. For the year 1892, gross earnings were $1,158,621, an increase of $256,220, or 28.47 per cent. Net earnings were $408,993, an increase of $135,625, or 49.62 per cent. Fixed charges for the year were $356,750, leaving a surplus of $52,243. Interest charges for 1893 will be $425,000.

Net earnings for the first five months of 1893 were $117,212, an increase of $20,274. During this period the company suffered serious losses from bad weather and from a fire which destroyed a large amount of equipment. Earnings during June indicate net earnings for the year not below $550,000. Results for the year bid fair to exceed the estimates in the last annual report.

The Cincinnati Edison Electric Company has had steady growth during the year. The connections for light and power are equivalent to 21,278 incandescent lamps of 16 candle-power each. An advantageous contract has been made with the city for a long term of city lighting. The earnings of the company show a fair surplus over operating expenses.

On the Boston Exchange, Bell Telephone sold through a range of from 191 to 193, closing at 190 to 191. New England Telephone on limited sales through the week closed at 56. Erie Telephone closed at 44, a loss of a point. Fort Wayne Electric was bid 8½ and held at 9. Westinghouse Electric was bid 21½.

Highest and lowest quotations on the New York Stock Exchange:

	Highest.	Lowest.
General Electric.....	73⅛	69⅞
Western Union.....	84¾	82½
North American.....	9½	8⅝

New York, June 24.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week.

New Electric Railways.

NEWARK, N. J.—The Franklin township committee has granted the Newark and Paterson Electric Railway Company permission to lay tracks through the township, to connect the two cities.

BUFFALO, N. Y.—The Niagara Electric Railway Company; capital, $50,000. Incorporators, Harvey Hoag, M. L. Failing, J. G. Taylor and J. A. Kuck, of Buffalo, and others. The company is organized to construct a street railway between and in the villages of Pekin and Lewiston.

SELIN'S GROVE, PA.—The Selin's Grove and Sunbury Electric Railroad Company has been organized to build an electric street railway between Selin's Grove and Sunbury. The borough council has granted them right-of-way.

ENFIELD, CONN.—The Enfield & Somers Tramway Company; capital, $50,000. Incorporators, A. C. Matthewson, William Begg, H. C. Douglass and John Mibbleton.

ENFIELD, CONN. — The Enfield & Longmeadow Electric Railway Company; capital, $30,000. Incorporators, John L. Houston, J. Warren Johnson, Joseph N. Allen and Thomas S. Grant.

STAFFORD, CONN.—The Rockville, Stafford and Southbridge Tramway Company. Incorporators, ex Senator Edwin C. Pinney, Richard S. Hicks, C. H. King, W. E. Hanley and A. M. Young. The company is authorized to construct and maintain a tramway in Stafford, Ellington, Tolland and Vernon.

BELLEVILLE, ILL.—The city council has revoked all franchises for street railways heretofore granted, and all hopes of an electric line for Belleville have been abandoned for the present.

MANITOU, COLO.—The council has granted M. A. Leddy a franchise to construct an electric railway in Manitou.

SHENANDOAH, PA.—After a prolonged struggle the Lakeside Electric Railway Company has been granted a franchise to lay tracks from Shenandoah to Lakeside.

NASHUA, N. H.—A bill to charter the Kearsarge Mountain Electric Railroad Company will be introduced in the legislature. The line is to run from the Northern Railroad, at Potter Place, to within a short distance of the summit of Kearsarge Mountain, then descending the southern side to Warner village. The total length of the line will be 14 miles.

MARTINSVILLE, IND.—The Indianapolis and Martinsville Electric Railway Company has asked Washington township to vote it $48,000. It intends building a line between the cities named in its corporate title, which will be the second largest electric line in the country, and will cost a half million.

BOSTON, MASS.—A number of Newton Center capitalists are interested in the formation of a street railway company, to build a line from Newton Center to West Roxbury and Boston.

CINCINNATI, O. — The Cincinnati Street Railway Company has increased its capital from $6,750,000 to $10,000,000.

EAST ST. LOUIS, ILL.—The East St. Louis Electric Railway Company has filed a certificate of the increase of the capital of the company from $150,000 to $500,000. This increase was made to enable the company to extend the lines it now operates.

NEW ROCHELLE, N. Y.—The Westchester Electric Company has obtained permission from the State Board of Railroad Commissioners to use the electric trolley power on the recently acquired roads in South Mount Vernon, New Rochelle and Pelham.

CANTON, O.—A company will be incorporated to build another electric railroad from Canton to Massillon.

GREENCASTLE, IND.—The Greencastle Street Railway Company has been reorganized and the capital increased from $10,000 to $1,000,000. The company proposes to use electric and horse-power. The following directors have been elected: Jesse W. Weik, Frank G. Gilmore, Henry C. Lewis, John S. Dowling and James H. Dietrick.

LOGANSPORT, IND.—The Logansport Street Railway Company has increased its capital from $10,000 to $200,000.

PORTSMOUTH, O.—The Portsmouth Street Railroad and Light Company has been incorporated with a capital of $125,000.

YORK, PA.—The York and Dallaston Electric Railroad Company has been organized with a capital of $60,000. Incorporators, Wm. H. Lanuis, Logan H. Marshall and Jno. W. Stacey.

TONAWANDA, N. Y.—The Elmwood Avenue and Tonawanda Electric Railroad Company; capital, $50,000. Incorporators, J. B. Zimmerman, of Tonawanda, J. F. Sheehan and L. P. Eberhard, of Buffalo. The company will build a three mile electric line in Tonawanda.

PHILLIPSBURG, PA.—A charter has been granted to the Phillipsburg and Houtzdale Passenger Railway Company for the construction of an electric railway, 50 miles long, in Clearfield County. Ex-Senator John J. Patterson, W. E. Wallace and others, are incorporators.

CLEVELAND, O. — George Anderson, of Detroit, Mich., and D. R. Cook, of Hastings, Mich., are purchasing the right-of-way for an electric railway, to be constructed from Cleveland to Chippewa Lake.

STILLWATER, N. Y.—The Stillwater and Mechanicville Street Railway Company has applied to the State Railroad Commission for permission to increase its capital stock from $20,000 to $60,000; the increase to be applied toward improved equipment, etc.

ALBANY, N. Y.—The Albany Railway Company is also an applicant for permission to increase its capital stock from $1,250,000 to $1,500,000.

Electric Light and Power.

CHICAGO, ILL.—The Tichenor Light and Power Company of the United States of America; capital, $1,000,000. Incorporators, Anson C. Tichenor, Alfred C. Hawley and Alonzo Hertig. The company will manufacture electrical supplies and equipments.

ELIZABETH, N. J.—The plant of the Suburban Electric Light Company, recently burned at a loss of $200,000, will be rebuilt.

LYKENS, PA.—The Citizens' Electric Light and Power Company will apply for a charter, July 25.

MIAMISBURG, O.—The Miamisburg Electric Company will establish a plant here for the manufacture of tempered copper, commutators, the Burnley battery and the Imperial dry battery. The company is capitalized at $100,000, and the officers are: Dr. T. V. Lyons, president; W. A. Mays, vice-president; William Gamble, treasurer; and Elwood Allen, secretary.

New Manufacturing Companies.

SUPERIOR, WIS.—The Eagle Electric Manufacturing Company; capital, $40,000. Incorporators, Alexander Striemer, E. N. Noble and O. J. Graham.

ST. JOSEPH, MO.—The Columbian Electrical Company; capital, $2,000. Incorporators, George C. Rough, Frank Barrington and Charles E. Roehl. The company will buy, sell and deal in all kinds of electrical apparatus.

NEWARK, N. J.—Joseph Wilkie, of Flushing, L. I., G. D. Mumford, of New York, and Lloyd McKim Garrison, of Orange, have filed articles of incorporation as the C. and C. Electric Company, capitalized at $1,400,000; $400,000 is preferred and $1,000,000 common stock. The object is to manufacture electric motors and appliances.

DETROIT, MICH.—The International Storage Battery Company, capital, $100,000, has been incorporated by Henry Woodward, Stephen J. Martin, DeWitt C. Meade and George W. Martin.

BALTIMORE, MD.—The Painter & Morrison Company; capital, $50,000. Incorporators, James F. Morrison, Gwynne E. Painter, David F. Pennington, George A. Muller and Edward V. Quigley. The company will manufacture and deal in electric switches, lamp switches, sockets and electric drop lights.

DETROIT, MICH.—The Standard Electric Company, of Detroit, has been reorganized with a greatly increased capital. The company has elected R. E. Turner, of St. Joseph, Mo., as president; W. T. Anderson, of St. Louis, Mo., vice-president; and W. H. Little, of St. Louis, secretary and treasurer. The company manufactures the Logan storage battery, but has been hampered by lack of capital.

SACO, ME.—The O. O. Electric Company; capital, $10,000. J. B. Duff, president, and H. B. Bennett, treasurer. The company is organized for the purpose of conducting a general electrical and mechanical manufacturing business.

KEOKUK, IA.—The Garton-Daniels Electric Company; capital, $20,000. Incorporators, John C. Daniel and W. M. Garton.

ST. LOUIS, MO. — The Atwood Electric Headlight Company; capital, $125,000. Incorporators, E. B. Roth, Michael Terber and others.

MEMPHIS, TENN.—The Memphis Tramway Sprinkling Company; capital, $100,000. Incorporators, John Raggio, John W. Alsup and W. E. Hancock. The object of the company is to sprinkle water by electric sprinkling cars.

New Telephone Companies.

PRESQUE ISLE, ME.—The White Mountain Telephone Company will build a telephone line between Presque Isle and Fort Fairfield.

Wenstrom Stockholders Must Pay.

A dispatch from Baltimore, dated June 23, states that the stockholders of the defunct Wenstrom Consolidated Dynamo and Motor Company are held to be liable on their stock to the creditors of the company by a decree signed by Judge Dennis on June 22. Judge Dennis directs the receivers of the company to collect from the stockholders the remaining 50 cents on the dollar, amounting to $250,000.

Good for Something.

(From Puck.)

Bleeker—Do you have those rods on your house to protect you from lightning?

Uncle Treetop—No, from lightning rod agents.

An Aluminium Lamp.

A remarkable kind of light has been successfully exhibited by Dr. Philip Lenard, of Bonn, and has formed the subject of a paper read before the Royal Prussian Academy of Sciences, at Berlin. Hertz has shown that the rays which proceed from the cathode of a Geissler tube, and are capable of exciting phosphorescence, will permeate thin metal. If, then, it were practicable to find a sheet of metal foil thick enough to be air-tight and opaque, yet thin enough to be permeable by this discharge, it would be possible to allow these rays a passage into the open air by closing an opening in a discharge tube with such a piece of foil. This idea has been realized by Dr. Lenard by means of an ingeniously arranged apparatus and a hammered aluminium plate 0.003 millimeter thick. This plate forms in the apparatus in question a shutter, which Dr. Lenard calls the "window," because, while quite impermeable to air and light, it allows the rays from a cathode at a distance of 12 centimeters to penetrate it freely. These rays render the air faintly luminous. A halo of bluish light surrounds the "window," and is moderately bright only on its surface. At the same time a strong odor of ozone is recognizable. Substances capable of phosphorescence, if held near the "window," shine with their peculiar light on the side nearest to it. All the phenomena of phosphorescence cease if a magnet is so applied to the discharge tube as to repel the cathode rays from the inner side of the "window." The atmosphere is a dull medium for the cathode rays to penetrate, coal gas is more permeable and so is hydrogen, while oxygen and carbonic acid are less permeable than air.

The Sound of a Sunbeam.

One of the most wonderful discoveries in science that has been made within the last year or two is the fact that a beam of light produces sound. According to Milling a beam of sunlight is thrown through a lens on a glass vessel that contains lamp black, colored silk or worsted, or other substances. A disk, having slits or openings cut in it, is made to revolve swiftly in this beam of light so as to cut it up, thus making alternate flashes of light and shadow. On putting the ear to the glass vessel strange sounds are heard so long as the flashing beam is falling on the vessel. Recently a more wonderful discovery has been made. A beam of sunlight is caused to pass through a prism so as to produce what is called the solar spectrum or rainbow. The disk is turned and the colored light of the rainbow is made to break through it. Now place the ear to the vessel containing the silk, wool or other material. As the colored lights of the spectrum fall upon it, sounds will be given by different parts of the spectrum and there will be silence in other parts. For instance, if the vessel contains red worsted, and the green light flashes upon it, loud sounds will be given. Only feeble sounds will be heard if the red and blue parts of the rainbow fall upon the vessel, and other colors make no sound at all. Green silk gives sound best in red light. Every kind of material gives more or less sound in different colors, and utters no sound in others.

A Fever Annunciator.

The London *Lancet's* Paris correspondent tells of an apparatus of recent invention for registering rises of temperature from friction in a machine, from fermentation in a mass of grain, etc. A small metallic bulb half filled with ether is sealed by a corrugated cover. When the temperature rises so as to expand the ether vapor sufficiently, the cover is straightened out by the pressure and made to close an electric circuit that works a bell. It is said that the inventor, M. Tavernier, cherishes the project of fitting up hospital wards with these bulbs, each of which, secured in a patient's axilla, shall operate a numbered bell in the interne's room, after the manner of hotel annunciators. By this means it is expected a sudden and dangerous rise of temperature in any particular case may at once be brought to the interne's notice.

KINDRED INTERESTS

Alexander, Barney & Chapin, 20 Cortlandt street, New York, are having a great run on "C. & C." fan motors.

The Berlin Iron Bridge Company, of East Berlin, Conn., are putting up a new foundry for the Watts-Campbell Company, at Newark, N. J.

The American Electrical Works, Providence, notwithstanding the money stringency, is doing a magnificent business every one of these hot days.

The Jos. Dixon Crucible Company's little card calendar for July is printed in red, and shows the famous Dixon pencils as used in properly celebrating the national holiday.

The Eddy Electric Manufacturing Company, of Windsor, Conn., is most pleasantly located now in commodious new offices in the Havemeyer building, New York.

The Interior Conduit and Insulation Company, of New York, is rushed with orders for the Lundell fan motor. They are doing a tremendous local as well as out-of-town business.

Have you a copy of "Galloupe's General Index to Engineering Periodicals?" You need one in your library. Order at once and send $3 with the order to the ELECTRICAL REVIEW Publishing Company, 13 Park Row, New York.

The Central Electric Company, Chicago, are furnishing the *Sentinel* building, of Milwaukee, complete with conduit and fittings made by the Interior Conduit and Insulation Company, for whom they are the Western agents.

The Electric Heat Alarm Company, 113 Devonshire street, Boston, has put forth an interesting illustrated catalogue describing its system, which is especially adapted to giving warning of over-heated bearings on machinery or shafting.

"Ward" arc lamps for incandescent circuits continue to be in great and popular demand. The Electric Construction and Supply Company, 18 Cortlandt street, New York, manufacturers of the "Ward" lamps are showing some very beautiful new designs in ornamental lamps.

The Electrical Engineering and Supply Company, now at 134 East Sixth street, St. Paul, will, on July 1, remove its entire stock and business to 249 Second avenue, south, Minneapolis, Minn. In your correspondence with this enterprising firm, remember the new address after July 1.

The B. F. Goodrich Company, Akron, O., manufacturers of soft and hard rubber goods, have issued a very taking and humorous advertising pamphlet, called "Diary of a Druggist." Of course, it contains advertising matter, but it is so interestingly put that it is a pleasure and a profit to read it.

The Babcock & Wilcox Company, 30 Cortlandt street, New York, have sent us a copy of the twenty-seventh edition of their valuable book "Steam." Besides much valuable information which should be in the possession of every user of steam, the book contains an extraordinary record for economy and durability of the Babcock & Wilcox boilers.

The General Incandescent Arc Light Company, of Nos. 572 to 578 First avenue, New York, are having remarkable success with their lamps. The satisfactory working qualities of their arc lights commend them to a public which is ever desirous of obtaining the best for the most reasonable amount. It is evident that they have "come to stay."

The Page Belting Company, Concord, N. H., have published a very attractive souvenir of the twenty-fifth anniversary of the founding of their business, which occurred almost simultaneously with the opening of the World's Fair. The souvenir contains a brief but very interesting account of the growth of the Page Belting Company's business, besides numerous illustrations of their factories, products and their two World's Fair exhibits.

Col. Albert A. Pope, president of the Pope Manufacturing Company, Boston, manufacturers of the Columbia bicycles, has issued a very interesting pamphlet entitled, "Errors in School Books." In a prize competition the school teachers of the United States discovered a considerable number of errors in text-books which are here mentioned. The respective publishers of text-books will correct these errors in future editions.

Mr. A. E. Bowers has entered the service of Messrs. Claflin & Kimball, Boston, who are sole agents for the new "Novak" lamps, and can be found at the office of the above company. He will in future take entire charge and look after this line of the business. They closed a contract last week with the Lynchburgh Electric Company, of Lynchburgh, Va., for one 100 horse-power generator, and also closed several contracts for small motors.

Messrs. Coupier et Drouart, of Paris, have placed upon the market some most excellent pieces of bronze statuary, small editions of famous pieces in the large art galleries. Many of these are susceptible of use for electroliers, several being remarkably well adapted to parlor and hall illumination. Messrs. Fischel, Adler & Schwartz, of 94 Fulton street, New York, are the agents for this firm, and have on hand a large supply of the choicest products of their manufacture.

Business is very brisk with the New York branch of the Mather Electric Company, 95 Nassau street, and they have recently added to their force the services of the following gentlemen: Mr. Henry M. Stiles, formerly with the Thomson-Houston Company, has accepted the position of electrical engineer. Mr. Harry W. Colby, formerly with the General Electric Company, of Boston, has accepted the position of general agent for the sale of power apparatus and lighting plants.

The Jenney Electric Motor Company, of Indianapolis, Ind., builders of high grade electric machinery, have issued a pamphlet containing numerous letters from some of their customers expressing satisfaction with the work done for them. These letters seem to confirm the claims made by the company for their machine, viz., utmost simplicity, highest efficiency, first-class workmanship, great durability, automatic regulation and reasonable price. Catalogues and other descriptive matter will be mailed free upon application.

"Queen" Apparatus at the World's Fair.—The standard electrical instruments exhibited by this company are attracting increased attention each day, and prove of considerable interest to all who appreciate strictly high class workmanship. The Armour Institute, of Chicago, is equipping an electrical laboratory in good style, and has already received some $3,000 worth of the instruments exhibited by Queen & Company. These are to be delivered in November, after the Exposition has closed. The manufacturers consider this as a happy compliment to their product, as Mr. Armour spares no money in making his equipment the best in the country.

A contract has been made for the laying of a new telegraph cable between the Isles of Shoals and Portsmouth, N. H., the same to be in operation by July 1. The cable will be 7¾ miles long and the cost of construction something like $5,000. A shorter cable will connect Star and Appledore islands, and the station on shore will be near the Wallis Sand life saving station in Rye.

The Pennsylvania Railroad and World's Fair Traffic.

The large number of people who are patronizing the Pennsylvania Railroad between the East and Chicago shows that the fame of "the standard railway of America," with its block signals and interlocking switches, is highly appreciated by the traveling public.

Another pleasant thing about the Pennsylvania Railroad is the excellence of the dining car service, which means so much to the traveler on a long journey. Some of the readers of the ELECTRICAL REVIEW may object to the strict discipline observed in the dining cars in regard to the sale of liquors on Sunday, but let that pass.

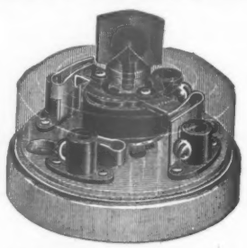
A REVIEWITE on a recent sultry Sabbath was dining in a Pennsylvania car, and unthinkingly (?) ordered a bottle of beer.

"Can't serve no likkers on Sunday, boss," replied the colored waiter.

"That's all right; just bring it along and I'll accept your apology."

"'Deed I can't, boss. Rules says 'No,' an' de conductor's a temp'rance gemman, too. Lectures to a temp'rance sassiety called 'De Band ob Hope'—dey hopes for what dey never gets. 'Deed I can't, boss. Give you 'pollinaris or ginger ale."

HART SWITCHES



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General Index

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